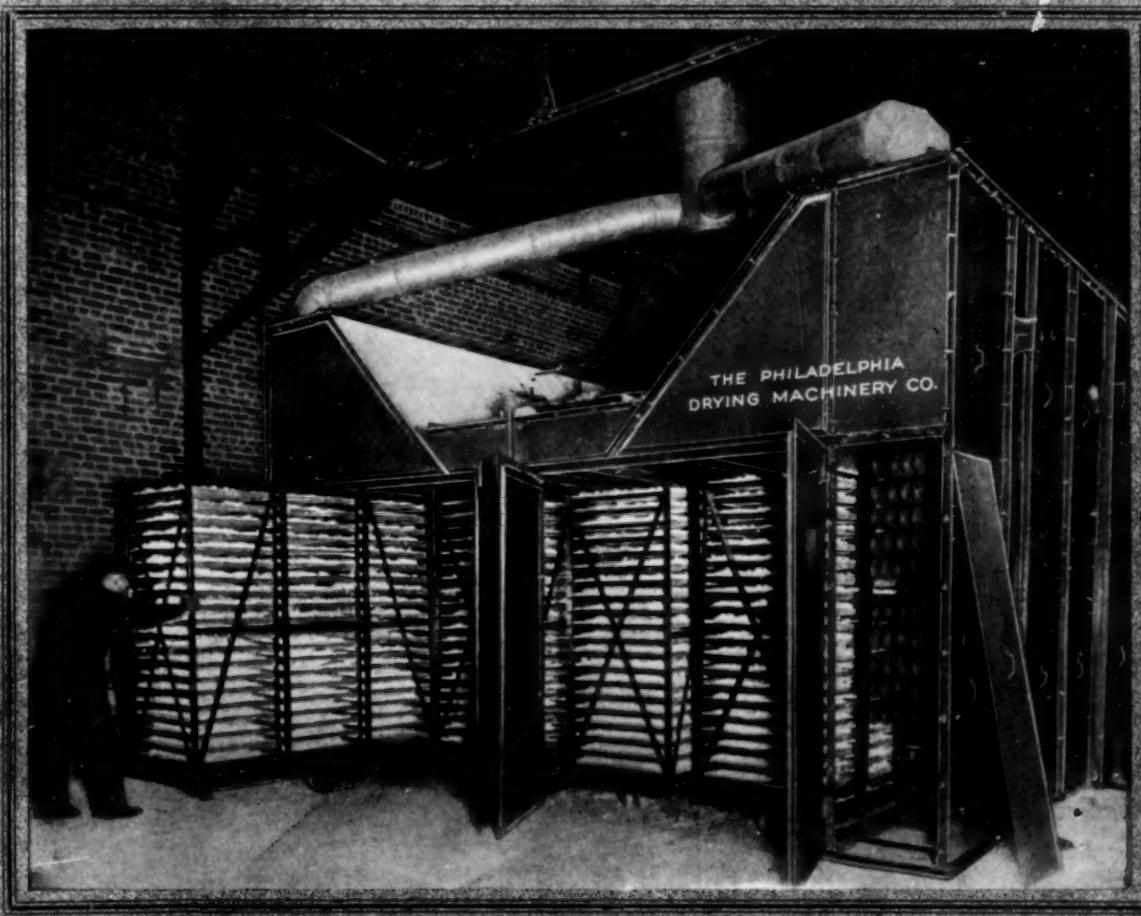


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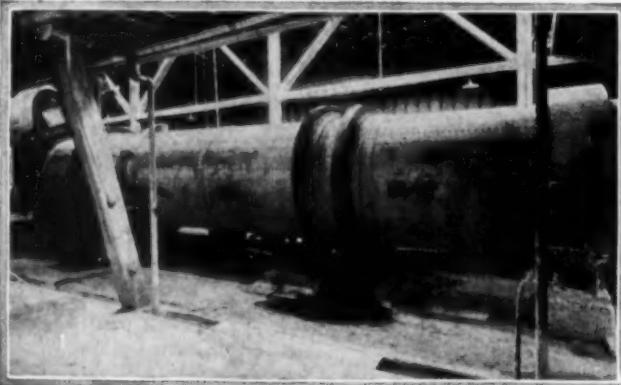
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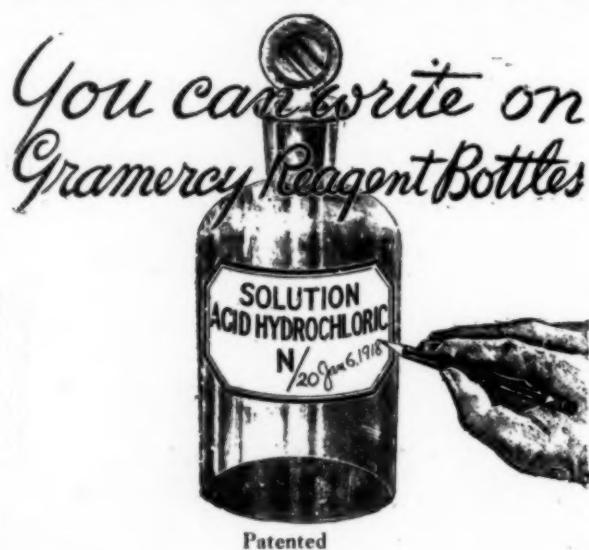
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Fair Dealing With Washington

IMPORTANT negotiations are now under way in Washington and much depends upon the forthcoming legislation. The chemical industry occupies a prominent position in these considerations, and Congress is naturally relying on the representatives of that industry for assistance in solving many of its problems. The industry in turn is relying on its representatives to present its case fairly and frankly, and it is therefore deeply concerned with the recent reports that this has not always been the case.

The hearings before the Congressional committee in charge of tariff legislation are occasions where willing co-operation and patient service are sorely needed. The committee is in search of certain definite information, and oddly enough it is not satisfied with broad generalities and sweeping statements of impending floods of cheaply made foreign goods. In attempting to fix a tariff rate in terms of production costs and foreign market values, the legislator must have specific facts and figures. The Senator who in recent hearings demanded data on costs, profits and dividends was well within his rights, although it must be realized, of course, that information of a confidential nature cannot always be given in the public hearings. There are ways and means, however, by which such data can be presented to Congressional committees, and our chemical manufacturers must at least show their complete willingness to meet these requirements.

The efforts of the Department of Commerce to be of real assistance to industry are also in certain instances being met in a half-hearted way, and here again the chemical industry is among the offenders. Many industrialists are betraying a manifestly selfish attitude toward this worthy enterprise. Apparently there is the fear that more information must be given than will be received, and that therefore the Government's activities are to be regarded with suspicion. Even the well-considered program for a useful statistical service is not receiving the genuine and frank support it deserves from our industries. Secretary HOOVER's broad plans for a comprehensive study of the facts and figures for all business demanded relatively little of the chemical manufacturer. Only a half-dozen important chemicals were on the list for production statistics, but still there are some of our producers who are objecting because they fear that the Government is encroaching on their business and they resent "government in business."

In many cases these same manufacturers are the ones who are seeking special favors from Congress. The very controversial measure of protection demanded by the dye industry, badly needed as it is, is still regarded in many localities as a special dispensa-

sation for a particular industrial group. The approaching expiration of the import control on dyes and organic chemicals also creates a serious emergency, and a special effort must be made to bridge the gap between August 27 and the final enactment of the permanent tariff. In the face of these special demands for vitally important legislation, can we afford to withhold any information from Congress? Obviously, we cannot. If mistakes have been made in the past, it is time they be rectified, for the chemical industry must adopt a frank and open policy in its dealings with the Government.

Alcohol Dyes and Industrial Supremacy

A COMMITTEE was appointed recently by the British Government to report on the dye industry, and its findings are being published serially in the *Chemical Age* of London. The industry began in Manchester in 1856 with PERKIN'S discovery of mauve. That much seems settled. Its decline and fall in England coincident with its rise and prosperity in Germany is a phenomenon for which the committee has tried to discover the reason. And after long research it gives as one of the two leading causes "the lack of duty-free industrial alcohol throughout a long and critical period during which the Germans, having the advantage of duty-free alcohol, were able to produce dyes at a correspondingly lower cost than British manufacturers."

Other attributed causes we shall consider later. We have already noted this finding, but it will do us no harm to ponder over the alcohol problem again. We can produce alcohol as cheaply as the Germans, and probably more cheaply than they, because we have the facilities, the technique and more abundant materials. The dye industry is also here. It needs the alcohol to make dyes, but not to drink. The Congressional mind, however, as exemplified in Mr. VOLSTEAD and his followers seems to hold that if alcohol goes into the apparatus in which dyes or the materials to make dyes are made, it must also come out with the product; that the product must be "booze," because the makers put alcohol into it.

It may seem easy to disprove such a postulate, and indeed it would be were it not for the fact that there's none so blind as he who will not see. The trouble is that in this country the problem of industrial alcohol has entered politics, and politics in its modern sense has almost ceased to be a host to reason or logic, or even the consideration of anything else than scare-heads. Its principal business is to swing the crowd before it can think, and when a crowd is once well swung, it does precious little thinking. This is not a pleasant thought, but unfortunately it is true.

For instance, last fall in Minnesota there was wit-

nessed the amazing phenomenon of the defeat of state-owned grain elevators on an issue of free love. We have no interest in either proposal; we give it merely as an illustration of swinging the crowd. The farmers either rightly or wrongly wanted state-owned grain elevators. An enthusiastic supporter of the somewhat radical idea recommended that voters read a number of radical books and in the list was included a work by ELLEN KEY. In one of her works were found some caustic criticisms of present conventions relating to the institution of marriage. This was construed to favor its total abolition, whereupon the opinion that free love and not elevators was the real issue was framed up and published broadcast by the ladies whose husbands were interested in privately-owned elevators. The farmers, including thousands of seasoned old Swedes and Norwegians with large families and all the traditional Scandinavian piety, protested in vain that they didn't want free love, that they wanted elevators and proposed to cling to their good wives—but the scarehead was well framed up, the crowd had been started at shouting and the protest against free love carried the day.

Now we have the dye, pharmaceutical, varnish and general chemical industries all mixed up in Congress, not with prohibition but with what THEODORE ROOSEVELT called "the lunatic fringe" of prohibition. Truly we are in a parlous state in regard to industrial alcohol.

Soft-Pedaling the Curtailment of Research

OF RECENT years it has been fashionable to make widespread public announcement of the research facilities maintained by manufacturing establishments. The public has been taught and can well believe that a company maintaining such agencies for investigation and development is apt to have the latest and the best product, continually improving it to utilize every advance in the art.

However, a new phase in research activities has been noticed with great regret during the times of depression which have come like an industrial blight upon the country during the past year. In this period many of the research and development laboratories of big corporations have been discontinued and still more frequently these departments have been reduced to a bare skeleton of their former glory. It is noticeable that when this has been done the corporations have been very modest in their announcement of the change or have altogether suppressed the news where suppression was possible. In this there is both encouragement and warning.

The encouragement comes from the fact that industry apparently recognizes that cutting off research and development work is really poor policy. It recognizes that it would be much better to continue these departments, for they are essential to efficiency and at no time is efficiency more important than in time of stringency. The fact that little mention is made of discontinuance of laboratories shows that the management of corporations knows that the public will look with suspicion upon tendencies in this direction. And the public may well ask whether the interruption of research does not mean that the corporation will no longer progress and that its product may fall behind in the race under the keen competitive conditions of the coming few years. The signs are so plain that "he who runs may read."

Simultaneous

Discoveries in Science

PHILOSOPHERS have argued that discoveries are made when the world is ready for them; that a man arises when he is needed, and his name is a matter of no moment. If, they say, CROMWELL had not been at Naseby, some other Puritan would have been Lord Protector. NEWTON was but an incident, apples were falling everywhere and gravitation could not long have remained undiscovered. The studies of any one of a dozen scientists would ultimately have led him to the discovery of radium, but the CURIOS happened to arrive there first.

About the only foundation for this theory is the undoubted historical fact that many of our most important truths were discovered independently and practically simultaneously. In not a few cases important conclusions were reached years before the world was ready for them, and then lay forgotten, only to be rediscovered when the time was ripe. Who can count the many controversies as to priority, both in and out of the patent courts? LIPPERSHEY in Holland and GALLILEO in Italy both discovered the telescope. KELLY in America and BESSEMER in England both invented the pneumatic process of making steel. The same day that NICHOLSON announced the presence of a new gas in the great nebula of Orion, a German, WOLFF, read a paper in Heidelberg in which he showed that two of the spectral lines which NICHOLSON could not explain were due to the fact that the nebula consisted of two parts.

The recent paper by JEFFRIES and ARCHER, published in these columns, on "The Slip Interference Theory of the Hardening of Metals," furnishes more striking evidences of simultaneous arrival at the same point by two widely separated investigators. At about the time their manuscript was completed another was read before the British Iron and Steel Institute by the Swedish investigator Dr. ARNE WESTGREN. Both papers contained the new experimental result, proved by X-ray analysis, that ferrite and martensite both contain body-centered cubic crystals of iron, whereas austenite contains iron atoms in face-centered crystals. The peculiar thing is not that austenite is austenite whether in Cleveland or in Gothenburg, but that its crystallographic nature should have been announced in two papers at the same time. A further fact, more than a coincidence, is this: An issue of the *Proceedings* of the Royal Society was on the way from England containing a paper (reprinted in this issue) by Dr. ROSENHAIN of the National Physical Laboratory setting forth views on the hardness of solid solutions substantially identical with those proposed by JEFFRIES and ARCHER.

A rather striking parallel can be drawn. JEFFRIES and ARCHER in their paper which was mentioned above say:

The resistance to permanent deformation, which is a general measure of hardness and strength, represents resistance to the beginning and propagation of slip Our knowledge of the structure of solid solutions is quite limited, but from the results so far obtained it seems that the atoms of the solute replace those of the solvent without substantial change in the space lattice of the latter. . . . The increased hardness and strength are traceable directly to increased interatomic forces, the attraction between unlike atoms being in general greater than between like atoms. We may conceive an additional mechanical factor in the form of a roughening of the slip planes due to the

presence of atoms of unlike size, or, as Bridgman puts it, a staggered arrangement of the atoms.

We now quote ROSENHAIN:

The forces acting on any atom of A, for instance, when one of its neighbors in the lattice is an atom of B, cannot possibly be the same as those acting on an atom of A entirely surrounded by atoms of A; there must be some want of symmetry in the forces acting on an atom so placed, with a result which is perhaps best expressed by saying that such an atom will be pulled slightly out of its proper place. . . . It is evident that such distortion must affect the internal energy of the whole system. Anything which tends to hinder the free occurrence of slip on the principal planes of a crystal will increase the hardness. . . . Any, even slight, distortion of the space-lattice of the crystals of a metal by the presence of "dissolved" atoms of another metal . . . must serve as a hindrance to slip on the crystal planes. Strictly speaking, in fact, the crystal "planes" have ceased to exist in such a slightly-distorted crystal. . . .

**Quality Pays
In the Long Run**

NO OTHER factor can be as potent in causing disaster for an industry as the failure of its customers to continue to buy the industry's product. At the present time the zinc producers find this as one of the factors in their industrial distress. If they were simply suffering from inability of their purchasers to use their product because of reduced scale of operations there would be no point in discussing their situation. But there is another factor in this case which makes the matter of particular significance.

Dr. H. FOSTER BAIN, director of the Bureau of Mines, in a discussion of this industry states: "The increasing use of black sheets (instead of galvanized) can be blamed in part on the increasing tendency, particularly during the war, of certain manufacturers of galvanized wire and galvanized sheets to use too thin a coating of zinc." In Dr. BAIN's opinion this has resulted in a loss of confidence in galvanized materials especially among the smaller users who have not had facilities for judging just why it is that they have suffered losses through failure of galvanized materials.

Undoubtedly most of the larger producers of galvanized materials did not follow any such short-sighted policy as to willingly furnish inferior products even when zinc was high or hard to get. It is the shyster of the industry who always indulges in such practices. And yet not only the shyster but also the reputable operator suffers.

In metal products as in every other line of business, honest quality in the long run is the most satisfactory product from the manufacturers' point of view as well as from the standpoint of the user. No industry can afford to permit any member of the business to have his product unnecessarily fall into disrepute as to quality. More than high-grade technology is needed. Broad co-operation in maintenance of industrial standards is also essential. At times it may seem that this co-operation gives the smaller producer an unfair advantage compared with the larger concern with which it is in competition and yet in the long run it is often found that the large operator gains fully as much as the small by this mutual support in the application of the best technology and maintenance of appropriate industrial standards. The next time a case of inferior quality among smaller producers arises, let everyone involved think of the present situation among the zinc producers.

**An Era of
Construction in Prospect**

THAT the people of the United States are going to be busy as soon as they can get on the right basis for being busy may be accepted practically as a foregone conclusion. The real question is what they will be busy about. Some have argued that we have such a large productive capacity that we can do much more than supply our own needs, and must have a large export trade. That raises the question what we should get for our exports. If we have a surplus of goods we scarcely want to be paid in goods, for the goods we cannot produce and still can use would hardly measure up well in quantity or value against the goods we could export. We do not want gold. If we accepted securities, we should probably be getting part ownership in construction works outside the country. Why not have construction work in this country?

That we can take care of our current requirements without working hard was shown by the experience of 1920. Men did not work hard then by any means, yet in many lines surpluses were created.

In construction work there is an unlimited field for our surplus energy, and it is obviously in that direction that the energy should be directed. We need more dwelling houses if we wish to be comfortable and if we can get them at the right price, while if the price is low enough we ought to abandon a great many of the dwelling houses we have.

The distribution of power presents an excellent field. Our system of power and heat generation has grown top-heavy. The last two doublings in coal production were less than fifteen years apart and the preceding doubling had required only ten years. From 1880 to 1918, thirty-eight years, instead of the production of coal doubling three times the production was multiplied by 9.5. Nothing like such a pace can be continued, as the old-fashioned methods of production and shipment cannot be improved sufficiently in detail. The solution is to adopt new methods entirely, converting coal at the pit mouth into high-tension current and making byproduct coke for such fuel as must be provided. It is easier and better to construct along that line than to construct more railroads. There is nothing the matter with byproduct coking except possibly the high level of construction cost as it has been lately. Of the coke produced in the United States last June about 86 per cent was byproduct and 14 per cent beehive, although as to capacity there is not far from a 50-50 division. That is only a beginning, however. The proportion of all coke that is byproduct may be fairly high, but the proportion of all coal mined that is coked at all is very low. Where there is water power it is of course far more economical to develop it than to mine coal.

In construction work there is no limit. Of food and clothing we can conveniently use only so much. With construction work the field is unlimited, the only problem being to make it pay. And in order to make it pay the cost must be sufficiently low. A great deal of progress in that direction has been made in the past few months. The condition is the same as that of a commodity market when there is a latent demand, but the commodity is not low enough priced. It is compelled to make its market by developing a suitable price.

Readers' Views and Comments

Oxygen Research of the Institut de Beauté

To the Editor of Chemical & Metallurgical Engineering

SIR:—A colleague with a high thoughtful brow sent me lately a circular of the Institut de Beauté de Paris which contains so much new chemistry that I venture to add a few excerpts from it to my former contributions on the unfamiliar aspects of science. The Institute, according to its circular, addresses itself to the culture of the human hair and its growth. It does not appear to extend its activities to include harvesting, or barberology.

The thesis is presented that "there is no such thing as a dead hair root" and it is claimed that no matter how bald we may be, the "roots" are all there, in the scalp, but in an atrophied condition. The proof offered in support is that if the roots were to die, Nature would expel them like so many splinters and that we should therefore have dreadful eruptions of the pate during the process of growing bald; and the irritation, according to the circular, would be beyond endurance. The same authority declares that "the roots of the hair and the roots of the grains and grasses of the field need one and the same nourishment" and that this is oxygen. "Introduce oxygen into the roots of the hair," it continues, "and . . . the most shiny bald pate responds to the nourishment just as a plant does to the air." "What would happen to a plant," is asked in the circular, "if you put it in a dark place and excluded all the oxygen from it?" From this we gather our first note that there isn't any oxygen in the dark.

In the preparation of an "oxygen product" to induce the atrophied roots of the hair to "breathe" and thus to grow, "we have done," affirms the publication of the Institute, "what science insists is absolutely impossible. *We have liquefied oxygen.*"

It may seem that this has been done before; indeed I recall your frequent references to the Linde, Claude and Norton processes, but it would appear from the revelations of the Institute that its savants have developed a remarkable allotropy of oxygen. For instance, if liquid oxygen, as prepared under the Linde, Claude or other patents, were applied to a bald spot, it might well cause the remaining hair to curl, but it would hardly make new hair to grow over the vacant spots. Dr. Metzger of the Air Reduction Company refuses absolutely to recommend applications to the scalp of liquid oxygen prepared by the Claude process for any purpose whatever, and even in the hottest weather, Dr. Metzger is very firm in this advice.

As evidence of the originality of the contribution of the Institute the circular declares that "Just what a step in scientific research this achievement is, only the medical profession can appreciate." This statement is, in itself, a credential of the Institute, because while I do not profess to know the mind of the medical profession I think I am in a position to say that the chemical profession does not appreciate it. We must remember, however, that there is a great deal of original chemistry in medicine. An eminent practitioner told

me once that the object sought in the aging of wines or liquors is "to get rid of all the ethyl bodies."

Another point brought out in the circular of the Institute which chemists do not understand is this: "The oxygen is an ether that evaporates as soon as the air touches it." It "disappears as soon as the vial is opened." But "by a long and tedious process in electricity" the members of the Institute have "imprisoned oxygen" and this is their "very own invention." "We have succeeded," they claim, "in capturing the ozone needed for the health of the hair roots and in bottling it in a fashion that will preserve the strongest quality of oxygen indefinitely." Then "even though the bottle be uncorked, the oxygen will not evaporate from this air-giving lotion, and only when it is rubbed into the scalp and the temperature of the body sets free the imprisoned oxygen can this genuine ozone be absorbed into the deep-down roots of the hair." After this is accomplished it is affirmed that "the hair will curl and wave naturally and vibrate with your own human magnetism."

Revelations come so fast in the foregoing that we can hardly catch them as they fly. But besides the note that oxygen will not keep in the dark we learn that oxygen is an ether.

The hunt for and capture of ozone is still a secret process, but I suggest that probably the Institute has its own preserves and shoots ozone with electric guns. Ozone is absorbed by the "deep-down" roots of the hair. This leads to a quest for a proper name for this product with new qualities.

How would "Osmotic Ozone" do? Or "Cute-oze" (cute from "cutaneous," not from "nifty")?

The synchronous vibration of hair of the scalp with human magnetism is also new. I once knew an old deacon whose tuft of chin whiskers used to vibrate with his own human magnetism after the absorption of one or two milk punches into the face above the beard, but this was not a scalp phenomenon. The Institute is entitled to all credit for the scalp shakes.

MARTIN SEYT.

Inventors Are Active

Despite the industrial depression, applications for patents during the first six months of 1921 broke all records. Applications for patents during that period numbered 45,005. This is nearly 300 more applications than the best previous half-year period. Although the demands on the Patent Office are increasing, its capacity is limited to the volume of business of twenty years ago. There is pending in Congress a bill providing for some additions to the force and for some increases in salaries. This bill probably will pass in the near future, but even it will not meet the exigencies of the situation. It seems probable that applications will continue to accumulate until the pressure becomes sufficiently great to induce legislative relief. The failure to provide adequate machinery to handle promptly all applications for patents is particularly difficult to understand, since the office is more than self-sustaining.

American Ceramic Society Summer Meeting

Announcement of Appointment and Scope of Activity of Full-Time Secretary for the Society—Important Effect of This Step on Development of Research and Industrial Advancement in the Clay-Working Business—Social Features and Plant Trips

PERHAPS the most successful summer meeting of the American Ceramic Society was convened in the pottery district of southeastern Ohio, with headquarters at the Hotel Courtland, Canton, Ohio, lasting for three days, July 25-27. These meetings are usually called for the sole purpose of visiting industrial plants in each particular district, with social features to bring closer personal relations between members. On this occasion the program was carried out by the local committee under the direction of Ira E. Sproat with such excellent results as to win the approbation of every member attending.

At the banquet Monday evening President Pence announced the action of the board of trustees in retaining the services of Ross C. Purdy to act as full-time secretary. In response to the requirements of the times and expressed desire of the society, the board has employed Mr. Purdy to serve the remainder of 1921 as organizing and next year as general secretary. The object of this action is none other than the object for which the society was founded, and for which it has for twenty-two years been maintained—"to advance the ceramic arts and sciences."

Mr. Purdy was called upon to give further details and responded in part as follows:

Abstracts of Mr. Purdy's Address

The organizing work of this secretary can be generalized in the words of the special committee in its report to the board of trustees, which report was accepted and approved, and the section under the caption "Duties of the Proposed Permanent Secretary" was made a part of the contract of employment.

The scope of the organizing secretary's authority is limited to "assisting," "supplementing," "supporting" and "aiding." He is to encourage, promote and execute only by the authority of, in the name of, and through the board, the committees, the local sections or the divisions, as each case will require. In other words, he is merely to assist, support, aid and supplement the existing agencies already provided for by the constitution and bylaws.

By the appointment of an organizing secretary to serve in the capacity of an assisting and supporting supervisor of the work of the committees, sections and divisions, the board of trustees for the first time has a means of co-ordinating and unifying the work of the entire organization on the one general program of advancing ceramic arts and sciences. Emphasis should be placed on the fact that the organizing secretary cannot and will not relieve the committeemen nor the officers of the local sections and divisions of their responsibilities.

Research financing by associated corporations is the vogue today, whereas in former years the industries supported general ceramic research without regard to special applications. As the industries progressed in

things technical, they learned the value of joining by groups in financial support of researches in which they were particularly interested. Thus their support of and interest in scientific and technical research gradually shifted from the general to specialized investigations. The advantages of group specialization, emphasized as they were by war conditions, was recognized by the American Ceramic Society by providing industrial divisions. These divisions have succeeded or failed according to the quality and the continuity of executive attention given by the division officers and also according to the extent to which they have enlisted their particular group of manufacturers in the support of scientific and technical research. It is to correct these shortcomings that the organizing secretary was appointed, for the success or failure of the division is the success or failure of the society as a whole in serving the different groups of ceramic industries.

The American Ceramic Society has been and will continue to be the principal agency for the advancement of ceramic arts and sciences. In the early days, when there was but one collegiate department of ceramics, no federal bureaus, and when the manufacturers were jealous of their trade secrets, Prof. Edward Orton, Jr., did a great service to the ceramic industries when he persuaded a few ceramic workers to join in the founding of the American Ceramic Society. Since 1899 this society has continued steadfast to its original purpose, and was and is deserving and is enjoying the support of the ceramic industries, with the result that today our industries are second to none and equal to any in the world in technical attainments.

It is intended that this society shall continue as the leading agent for the advancement of ceramic technology, and it is assured that each division will enjoy in this purpose the full co-operation and backing of its respective group of manufacturers with the same zeal and for the same purposes with which, in previous years, the society as a whole was supported.

That all this may be realized and thus carry to full fruition the purposes and hopes of Prof. Orton and his collaborators, the board of trustees has appointed a full-time secretary and given emphasis to the organizing duties as distinct from the routine, and it is to the carrying through of this program that I, the appointed secretary, pledge my ability, zeal and singleness of purpose, and it is to this that the full co-operation of each and every member of the society is asked.

The Board of Trustees' Meeting

Tuesday night the board of trustees met for dinner and a business meeting. The more important business taken up concerned the activities of the new organizing secretary. Part of his program as submitted to the board was read before the members at the Elks Club luncheon in East Liverpool, Ohio, Wednesday noon. Abstracts follow.

A general program, to which all can work, is essential to definiteness in policy, cohesiveness in organization and maximum success; the prime requisites to obtaining the largest returns in things accomplished with the expenditure of the least time and money. To this end there are two suggestions, (1) that a conference be called of members of the board, officers of divisions and local sections and chairmen of standing committees, and (2) that a program be prepared for such a conference, which program can be issued and freely discussed prior to the conference.

One of the fundamental requisites to the most perfect attainment in the organized activities of a society like ours is close contact with the individual members of the society by finding some way for each to be actively



ROSS C. PURDY

engaged in or constantly informed of what is being done or planning to be done in the section and division to which he belongs, and to be kept informed of the plans and doings of the committees. Such may be thought accomplished as far as it can be by the reports now appearing in the *Journal*, but this is not quite correct, for those reports are lacking in the personal appeal to co-operate in the planning and execution of the work. This means, in the last analysis, that there is a need of and a virtue in an inter-member and inter-group of members correspondence that will instill a desire to serve, a feeling of welcome for his service and opinions, and a co-operative obligation and interest.

It is no mere phrasing of general thoughts or theories, but a bald statement of facts, that, because our society has been without a definite and known general program on which each and all groups within the organization could be working, (1) our members are not as well satisfied as they should be, (2) the associations which would naturally look to us rather than else-

where for the very service for which our society is maintained have not known that we would thus serve them, and (3) some of our standing committees have not known what or how to do and where to obtain information. Neither the board nor the *Journal* has met the situation just described and could not have done so in any other than some way as is here proposed.

DIVISIONS

The plan of organization and general purpose of the divisions are defined in the constitution and bylaws, but the constitution very properly leaves to the decision of the division members the manner in which these purposes shall be served. Although a detailed arbitrary plan or program cannot be made alike for all divisions, there are some things that could be practiced in common by all: The divisions should have semi-annual or quarterly meetings for consideration of research problems and plant visitations. One or more of these meetings, when possible, should be held in conjunction with meetings of trade associations.

Each division could plan these mid-year meetings in part as institute meetings for the benefit of superintendents, foremen, etc.

Opportunity could be solicited for reciprocal participation in progress and contributions to literature with associations of users of the ceramic materials.

There should be a close affiliation of the standards committee of each division with the committees in the American Society for Testing Materials having like interest, such affiliation being by one or more members of the divisional committee having membership on the A.S.T.M. committee. A way for our society having official representation as a society on all A.S.T.M. committees dealing with ceramic products is now being devised.

Each division should have a definite program of research with assignments to federal, school and industrial laboratories, involving, when feasible, plant-scale trials. There need be no curtailment of reports of private and individual researches, but co-operatively planned and executed researches among the division members would make much for teamwork.

Co-operative research finances by persons or organizations outside of the division should have such supervision by the secretary as shall be decided by the board of trustees in general and the division in detail, but understanding should be had with the laboratories and all other parties concerned that the results must appear first in the bulletins of the society or the supporting associations rather than as announcements by the laboratories to trade journals.

Reports of plans for co-operative researches and progress reports should be made to the society as a whole as news propaganda that creates appreciation for the society. This would in no way hinder or detract, but would render a service beyond and aside from the actual result obtained.

A definite schedule of meetings of the divisions should be agreed upon so as to prevent conflicts of dates and also to permit of time and place distribution as would best promote the society as a whole without loss to the purposes had by any of the divisions.

LOCAL SECTIONS

With the exception of the New Jersey Section, which has had a definite goal, the local sections have been without definiteness in purpose and program of pro-

cedure, which lack has resulted in much misspent and early spent enthusiasm. They have found no way of interesting the local manufacturers in the society through the local section.

It is true that the problem of each section is different in many respects, but unless these sections are prompted to do for their district that which the activities of the society as a whole will prompt the manufacturers to want, other agencies will usurp our "rights and benefits."

To be definite with a concrete example, the local sections covering Zanesville and East Liverpool could with profit to all concerned organize institutes in these cities, holding classes, operating a laboratory and providing for lectures, etc. The local manufacturers would support such institutes and it would be of advantage to them that the institute was being managed jointly with them, they carrying the financial responsibility and our society through the local sections the instructional responsibilities. Unless our society promotes such enterprises in different sections, the local interests will do this and the society thus lose opportunities.

Local sections should have regularly scheduled meetings and much attention should be given that the programs are attractive.

Co-operation in joint meetings with local sections of other societies should be encouraged, but in these the American Ceramic Society section should do its share.

The local sections should make a list of the ceramic concerns and important users of ceramic products in their district and assist in compilation of data whenever any agency within the society should issue a questionnaire.

There is a need of redistricting of local sections and a need of keeping the section officers notified of members leaving or moving into their districts.

CHANGE IN CHARACTER OF JOURNAL

In the past the *Journal* has been the society's main point of contact between the members and will continue to be such until the local sections, divisions and committees begin to function under the stimulus of the board through the secretary. The *Journal*, however, has not served as successfully in this respect as it would if changed to include "industrial journal" features.

We have lost considerable of the personal or human element in our publications through loss of the discussions, but even a trade journal with the discussion added to the technical papers would not actuate the members to research, either individually or in groups, as would more direct stimulating methods. In every organization it seems to be necessary to have frequent personal contact and a subject of common interest other than the *Journal*.

It is wise for the society to consider adding the news feature and shop discussions to the two divisions the *Journal* now has and in addition to this make more use of bulletins than we have in the past.

ACTIVITIES OF THE STANDING COMMITTEE

In the correspondence relative to full-time secretary, there were suggestions of how the committee on research could co-ordinate its work with the work of the divisions. There are overlapping interests in this instance which cannot be removed and which, if properly directed, would really be of benefit. Similarly, there

are overlapping interests and duties among the different committees.

The programming of the activities of the committees would depend largely on the general program adopted for and by the local sections and divisions; hence the importance of the conference.

CENTRALIZATION OF BUSINESS AND ACTIVITIES

This is a question for decision by the board, but there are interests involved aside from those of the board. It is true that the selection of an editor and determination of official relations between the general secretary and editor are to be made by the publication committee and the board. It would seem to be worth while, however, for such a conference of executives as is here proposed to discuss this and perhaps formulate recommendations.

AFFILIATION WITH THE NATIONAL ASSOCIATION

We accepted affiliation with the National Research Council without members of our board (and apparently the appointees on the Research Council committee) knowing just what the affiliation meant in obligation, liability or benefit to either party. For four years we have kept ourselves blind to the possibilities and limitations in our affiliation with the National Research Council, with the result that our committees have served the council wholly, our society being concerned and credited only in a very incidental way.

It is a duty to ourselves in particular and to the ceramic fraternity in general that the Research Council committee inform us on this question of our affiliation with the Research Council.

There are three items in this connection worthy of discussion in this suggested conference: (1) Should not the personnel of the Research Council be representative of the different divisions and of both the laboratory and the plant, and (2) should our society join the Engineering Division of the council as well as that of the Division of Chemistry, and (3) should ceramists be styled as a group of ceramic chemists, whereas a large part of ceramic work is engineering and the largest part of graduates of ceramic courses are called engineers?

The American Society for Testing Materials offers an opportunity for our society to co-operate officially with manufacturers and users of ceramic products in the work of standards and methods of testing, etc., that would bring into prominence before the technical and scientific world the service that we are rendering. This is important, and as it would touch upon the particular interest of each group in our organization, it should be thoroughly investigated and presented to the suggested conference.

SOURCES OF REVENUE

Final decisions on finances are left with the board, but to know in what way our resources can be increased requires acquaintance with the men of affairs in the several industries which only representatives from that group can have. Then, too, there are related interests which would ally with us in the support and prosecution of co-operative researches. The possibilities and extent of such alliance are properly a subject for general discussion.

There are other topics which properly would come before such a conference for discussion and recom-

mendations, but it is thought that the foregoing suggestions are sufficient to be a basis for decision as to whether such a conference should be called.

Plant Visits and Social Features

On the morning of Monday, July 25, visits were made to the Dueber Watch Case Co. and the Hamden Watch Co., in Canton, Ohio. Among details of production were the recovery of waste gold products to be used in plating cases involving pulverizers, briquet machines, blast furnaces, melting reverberatories with sliding hearths and electroplating apparatus; heat-treating processes for the watch case parts and plant for enameling watch dials.

In the afternoon a trip to the Bonnot Co. enlightened the visitors on methods for the manufacture of modern clay-working machinery. The Canton Stamping & Enameling Co. plant occupied a considerable part of the afternoon. This company produces a mottled gray kitchenware by burning the enamel in one firing. The steel is shaped to proper dimensions in a machine shop equipped with large stamping tools, electric spot welding outfits for attaching handles and annealing ovens. The next step involves pickling in large vats in sulphuric acid solution. From the pickling room the ware is transported in small industrial cars to the dipping hoods and washed in slightly acid solution. To this

wash solution is added a small quantity of sulphate salts. After the ware is hand-dipped in the enamel slip it is placed on rack cars to dry slowly. During drying the rust spots from the sulphate solution appear in irregular formation throughout the white enamel. When the ware is burned these spots fire to a dark gray, giving a mottling of dark and light gray spots over the surface of the finished piece.

Delightful banquet and evening entertainment were provided at the Congress Lake Country Club. This was the outstanding social event of the meeting and was well concluded by informal dancing.

On Tuesday the Richardson compartment kiln equipment at the Alliance Brick Co. held the interest of the visitors all morning. After a pleasant luncheon at the Alliance Country Club the party was carried by automobiles to the Sebring potteries and the Strong Enamel Co. at Sebring, Ohio. Returning to Canton in the evening, some of the members attended an informal smoker, while others with their ladies danced till a late hour at Myers Lake.

Wednesday was spent at East Liverpool plants. Luncheon was at the Elks Club, where refreshment and food added zest to speeches and applause alike.

Later issues of *CHEMICAL & METALLURGICAL ENGINEERING* will describe the Ohio ceramic plants in detail.

Low-Temperature Carbonization*

BY SIR GEORGE BEILBY

I HAVE for many years taken a deep interest in the production of a solid smokeless fuel for domestic purposes by the carbonization of selected coals at 550 deg. to 600 deg. C. The resulting coke is entirely free from smoke-producing hydro-carbons, while still containing 10 to 12 per cent of volatile combustible matter, which burns with a very slightly luminous, perfectly smokeless flame. When the coke is kindled, it becomes enveloped by these flames, which quickly raise the surface to incandescence. Undoubtedly, if this smokeless solid fuel could be produced at a cost permitting of its being sold at little more than the price of the coal which it would replace, it would lead to a complete revolution in domestic heating, and, among other good things, to the abolition of black smoke from house fires. This attractive prospect has been spread before our eyes for many years by enthusiastic inventors and company promoters, yet its realization seems always to move a little further into the future!

From the experience of the past two years at the Fuel Research Station with a considerable variety of coals, we know with certainty the yields and quality of the gas, oils and coke produced under definite conditions, but this knowledge is only the first step in the inquiry. For, until we know with equal certainty the cost of producing these, and the markets in which they are to be disposed of, no economic balance sheet of any real value can be arrived at.

Let me illustrate the market uncertainty by a few comparative figures. Assume that 15 gallons of fuel oil suitable for naval use can be obtained from a ton of coal. Six months ago the value of this oil could safely be taken at 1s. per gallon, and the 15 gallons

would have realized 15s. Today the price of this oil is only 4d. per gallon, and the product would therefore only realize 5s.—a drop of 10s. per ton on the coal carbonized. It is obvious that a method of carbonizing which would have paid its way handsomely six months ago would today result in a loss. My own belief is that low-temperature carbonization can only be established on a sound commercial basis with low operating-costs and a very moderate margin of profit.

Prior to 1914 the shale oil industry in Scotland was distilling 3,000,000 tons of shale per annum. The entire cost of the carbonizing operation, for labor, maintenance and fuel, was 1s. 6d. (36.5c.) per ton, and the margin of profit on which fair dividends were paid was 2s. 6d. (61c.) per ton. Unless the costs and profit margins of low-temperature carbonization can be reduced to the modern equivalents of these figures, the prospects of its development on a large scale would not seem to be particularly hopeful, from the national point of view.

If low-temperature carbonization is proved to be a feasible operation commercially, it would find its first and most natural application to the 35,000,000 tons of coal used for domestic purposes. Were this coal all carbonized, it would produce about 2,000,000 tons of fuel oil. The motor spirit produced would amount to about 100,000,000 gallons.

The capital expenditure required for the installation of carbonizing plant for 35,000,000 tons of coal per annum would be of the order of 30 to 40 millions sterling (\$175,000,000). A gross profit of 5s. (\$1.20) per ton of coal carbonized would provide 10 per cent for interest and 10 per cent for depreciation on this expenditure.

When coal is used for steam-raising under the best known conditions, it is obvious that there is little to be gained in thermal efficiency by any preliminary sorting out of the thermal units of the coal into fuels of higher availability.

*Extract from the James Forest Lecture on "Fuel Problems of the Future," delivered June 28 before the British Institution of Civil Engineers.

The Economy of Modern Grinding Methods

**Preliminary Statement Regarding the High Cost of the Obsolete Grinding Plant and an Appeal to the Operator to Study Fundamental Principles of Reduction—
—Classification of Grinding Operations**

BY HARLOWE HARDINGE

GRINDING is a subject so broad and so involved that an attempt to cover the entire field in a short article would be a waste of effort. On the other hand, it is a process thought by many to be of little importance, as compared with others, in their plant. The general attitude taken toward grinding is that it is a necessary evil and that the operator might as well make up his mind that he is going to have trouble, and let the matter rest at that.

In the last few years there have been such strides made in simplifying and standardizing methods of grinding that the manager of the modern plant no longer considers grinding to be "the fly in the ointment" of an otherwise smoothly running plant. It is the aim of this article to point out why there has been so much trouble in the past and how it is possible to eliminate, to a great extent at least, the waste that is occurring in so many plants where materials of all kinds are ground.

The old hand-to-mouth method of operating that has been in existence in industrial plants throughout the country is gradually dying out and those in charge are realizing that modern equipment, although it may be more expensive than the old style in the initial cost, is far cheaper in the long run, and when once installed causes no trouble. In the old days the first cost was the chief consideration and the machinery soon ground itself to pieces and the operator found he was paying more each year for repairs than the original purchase price of the machine.

Business will soon be procured on a highly competitive basis. The manager whose main thought in equipping his plant is first cost rather than ultimate cost of operation will find that he is out of the running; he will not be able to compete with the man who figured on staying in business and operating at a minimum cost, not only for one year but for many years, with the same equipment. It is very gratifying to see that so many companies have forsaken the old ideas and have rebuilt or are redesigning their plants so as to be able to stand the close competition which is bound to come.

ACCUMULATION OF GRINDING MILLS

It was common practice several years ago for the millman to try first one style of equipment and then when a salesman came along who recommended another style, with its supposed marked advantages, he would either throw out the old equipment or install a new mill alongside the old, with the chances that the new mill would have little or no advantage over the old. After this was done several times and the plant was filled with all sorts of grinding devices, the operator would give up in disgust and absolutely refuse to entertain a new proposition. He would worry along with the equipment he had, continually buying repair parts and becoming thoroughly convinced that what he had was as

good as anything for handling his problem, even though he would admit he was shut down for repairs more than he would like to be. He would also excuse the situation by saying that no grinding equipment could run more than 75 or 80 per cent of the time on his particular material.

Based upon his experience with grinding equipment he had operated, he possessed strong ideas on the principle of grinding, and tried to make every problem substantiate his claims. This condition, while fast dying out, still exists in many fields, and it is in these fields that grinding in general is about fifteen years behind the times. It is just within this period that other methods have been worked out, so that now, unless these old-time operators and managers make a study of modern methods, they will soon find themselves out of the running. They must know something about grinding other than the ideas that have been forced upon them by the operation of the particular equipment they have used, in the particular way that they desired to grind.

GRINDING PRINCIPLES AND EXPERIENCE

A person may get his nose so close to the grindstone that he cannot see an obvious solution coming right to him, and cannot see how the operation, under other conditions, is at all analogous to his.

As a striking example of what a broader knowledge of grinding will do to help solve difficult problems, there was a case brought up recently by a wide-awake manager handling diamond-bearing clay, which had to be disintegrated in order to free the diamonds. This manager spoke of the trouble that was encountered due to the diamonds remaining in the mill longer than necessary, which resulted in a tendency to cause breakage. As this problem had never confronted the manufacturer of this particular grinding device before, there was no direct method, except by guesswork, of how to correct this trouble. By referring to the solution of a problem of grinding barytes containing a small amount of silica—which had a tendency to remain in the mill and be ground up, but which later by a simple adjustment was discharged without being ground—the problem of getting rid of the diamonds without breaking them was solved, and the operation made highly satisfactory. It is this application of one method to another problem which is directly responsible for the enormous strides which have been made in grinding methods within the last few years.

The matter boils itself down to just this: In order to keep abreast of the times the operator must study the fundamental principles of grinding in addition to those which he has evolved from his own experience. The operator must also know what he is buying and how it compares with other devices to do the same

work from all standpoints, particularly that of operating cost. When this study has been made, he will no longer be in the position that he was a few years ago when he installed equipment in a more or less haphazard manner, and trusted too much to the salesmen's theories, which are often warped, to apply to the particular device then being advocated.

EXCUSES FOR THE OBSOLETE PLANT

The following are some of the reasons why many operators have failed to standardize on grinding equipment and why so many plants are now out of date:

Pulverizing Usually a Side Issue. In many plants, grinding is not the main item of expense, or even if it is, it may not receive sufficient attention.

Principle of Grinding Not Comprehended. The operator usually evolves principles of grinding which are biased, and while correct to some degree, are not broad enough to allow him to get the most out of the equipment he has, to say nothing of getting the right sort of equipment to handle his particular problem.

First Cost Too Often Considered as Most Important. A very grave mistake is made when pulverizing equipment is bought mainly on first-cost basis, for the chances are it not only operates on the wrong principle but is inferior in design and construction and will be much more expensive to operate as compared with more costly machines offered at the same time.

Lack of Knowledge of Operations in the Same Field. While in some fields operators take full advantage of the information of the grinding done by their neighbor, operators in other fields show no interest in what their neighbor is doing and do not believe the information obtainable from their neighbor could possibly be of any use to them.

Lack of Interest in Other Fields of Grinding. The operator seldom takes much interest in other methods of handling grinding problems than his own, while if he were alive to the situation he might be able to apply the other man's method of handling his problem to his own and be much better off.

Methods He Is Now Using Made Money for Years. The operator often goes on the basis that equipment he is now using has made money for him for years. Why is it not just as good now? The question will of course be answered within the next year or two, if he is one of those who insists on using equipment purchased ten or twenty years ago.

Limited Experience. Very often the operator has grown up with his plant and has not had an opportunity of seeing how others handle the same or similar problems. As a consequence he goes along year after year, using the empirical methods he has evolved, which could almost certainly be improved with broader vision.

Making All Cases Apply to His Limited Understanding. If a problem comes up which is new to him, he will apply the principles he has evolved from his experience to this particular problem, and if his experience is limited, the chances are he will not be able to solve the problem as satisfactorily as the man who has made a broader study.

Unbiased Principles of Grinding Hard to Obtain. The user of pulverizing machinery is to be excused in a great measure for a lack of knowledge of grinding, as there is very little published on the subject. What information is published is either written from the

standpoint of one man's knowledge of a particular problem, which is limited in scope, or the information is obtained through salesmen, who unintentionally distort fundamental principles to suit their purpose.

Information obtained from other operators is valuable, as it is concrete evidence of what has been done under specified conditions. On the other hand it is often bad, first because it gives a biased viewpoint, especially when the use of the equipment for a special case has been subject to question by others, and second, because the operator using this equipment will try to prove his point and thereby substantiate his actions.

In some cases, especially where the field for the particular product being manufactured is limited, deliberate attempt is made to belittle the grinding equipment, even though it is operating with a high degree of satisfaction and efficiency, the object of this being to steer the competitor clear of equipment that is keeping production costs below the average.

TYPES OF GRINDING OPERATIONS

In order to give a slight idea of the enormous field of grinding, the table on p. 231 mentions some of its applications. Further details as to just how these problems are solved will be taken up in a later article. The object of this paper is to give a slight idea of the large scope of the modern grinding methods and why no two problems are alike.

Grinding, in general, may be classified under two main headings—wet and dry. Each of these may be subdivided into: Granular grinding, medium fine grinding, fine grinding, extremely fine grinding (with special applications), as shown in Table I.

In the case of granular grinding a product is desired with as small an amount of "fines" as possible, the average requirements calling for a product which passes a 4-in. opening and as much as possible remains on 10-, 20- or 30-mesh, as the case may be.

For medium fine grinding, most cases call for a product which passes a 20-mesh screen, the amount of "fines" produced being of little importance.

In the case of fine grinding, it is desired that as much fine material be produced as possible, commensurate with economical operation. Usually the specifications will run anywhere from 90 per cent through 100-mesh to 95 per cent through 200-mesh.

For extremely fine grinding, the specifications are very rigid and often call for a product so fine that it will all pass any screen manufactured. Therefore other physical tests must be resorted to, such as by microscope, feeling of grit between the teeth, by a spatula on glass or by a predetermined settling rate in water or air.

GUIDE FOR THE OPERATOR IN PURCHASING GRINDING EQUIPMENT

As no two grinding problems are alike, it is necessary to treat each separately and cover all the points which will affect the ultimate cost of operation.

First cost is important, but is secondary when compared to the cost of operation. Unless both are carefully considered, the operator is storing up trouble for himself in the months and years to come.

In considering grinding equipment of several makes, it is well to tabulate answers to the questions in each case, covering the main factors that are liable to determine the outcome of the purchase. These questions may be summarized as follows:

Is it the type of equipment to perform your work properly?

What is the total first cost of equipment and auxiliary apparatus f.o.b. factory?

What is the total cost of freight for equipment and auxiliary apparatus to go with this equipment, if any?

What is the cost of erection, including buildings, foundations, etc.?

What floor space is required?

What head-room is required?

Is the equipment self-contained?

Is it easy to inspect when located in the building as you have planned?

What power is required to start and what power to operate?

Is the equipment and lay-out designed so that it is dustless, if grinding dry or water-tight and clean if grinding wet?

What repair parts will have to be kept on hand?

What will be cost of repairs per ton of material ground?

What labor will be required to operate the grinding equipment? Will it have to be skilled and how much time must be allotted?

What percentage of operating time is assured after the equipment has been in operation one year?

Is the equipment simple in design and does it require constant attention to keep oiled or parts tight?

What facilities are there for feeding or discharging automatically?

Is the unit as a whole flexible—i.e., will it wear itself out if underloaded or overloaded?

What troubles are liable to follow, either in loss of production or otherwise, due to choking or jamming of working parts?

Has estimate of capacity been based upon actual conditions that you will maintain, such as maximum size of feed, fineness of product, moisture content and hardness of material?

In the old days (and in some cases today) an operator had no idea of what it was costing him to grind. All he knew was the total amount he spent each month for his entire plant, but he did not segregate the cost of labor, power, repairs and miscellaneous expenses to each operation. The old hand-to-mouth method is rapidly dying out. It is possible to estimate very closely what the total grinding cost will be.

Grinding costs are usually segregated as follows:

Power	Delays
Labor	Interest on investment
Supplies	Depreciation
Repairs	Miscellaneous

Some operators are not familiar with the method of figuring these costs, and the examples given in Tables II and III will be useful.

The first case shows typical itemized costs of a modern grinding device, pulverizing medium hard limestone at the rate of 15 tons per hour, grinding dry, the feed going to the mill all passing a 2-in. ring and the product all passing 20-mesh, with 50 per cent through 100-mesh. It must not be forgotten that this cost is based upon a given operating condition and that larger tonnages under the same condition will reduce the cost, and conversely, the cost will increase as the capacity and size of equipment are reduced.

The second case is a striking example of the cost of dry grinding by the older methods, many of which are being employed even today. The figures given are averages and do not cover any particular type of mill, but cover the same items based upon the same unit cost.

Under item "Interest on Investment" the same total amounts were used in each case. The cost of the mill itself for the new installation was assumed higher than for the old, but when accessory equipment, freight and all erection charges were figured in, the total cost was approximately the same.

The reader may not agree with the method of calculation throughout, but as comparison is being drawn, it

TABLE I. CLASSIFICATION OF GRINDING

DRY GRINDING

Granular Grinding

Carborundum, emery, silica and ganister rock	For abrasives.
Salt	For table use.
Iron and metals	For recovery from gangue or waste.
Chemicals	For aid in chemical processes.
Grog	For manufacture of tiles, porcelain ware, etc.
Mica and slate	For roofing.
Asbestos	For obtaining fiber.

Medium

Limestone	For asphalt filler and agricultural purposes.
Barytes and coal mixture	For manufacture of paint (base).
Phosphate rock	For fertilizer.
Sulphur	For chemical compounds.
Iron and minerals	For concentration or separation by special processes.
Hard rubber	For manufacture of rubber composition.
Sawdust	For chemical purposes.
Cast-iron borings	For chemical purposes.

Fine Grinding

Limestone	For the manufacture of cement.
Clinker	For the manufacture of cement.
Coal — bituminous and anthracite	For burning under boilers, in kilns, driers, furnaces, etc.
Grain—various kinds	For food purposes.
Feldspar	For pottery manufacture.
Mica	For use in tire trades.

Extremely

Barytes	Fine Grinding
Filter cake	For use as a paint base.
Grain	To prevent formation of lumps in further processes.
Pigments	For best grades of flour for food.
Pumice stone and emery	For the manufacture of paints.
Graphite	For dental purposes.
Talc	For pencils.
	For paper filler, talcum powder, etc.

WET GRINDING

Granular Grinding

Ores	For extraction of minerals by jiggling and table concentration.
Clay	For recovery of diamonds.
Graphite schist	For recovery of flake graphite from waste rock.

Medium

Ores	Fine Grinding
Foundry waste	For extraction of minerals by amalgamation and flotation processes.
Iron pyrites	For reclamation of metal contained therein.
Ores	For manufacture of sulphur.
Mica	Fine Grinding

Fine

Feldspar	For extraction of metal by cyanidation.
	For wallpaper trade.
	For use in pottery manufacture.
Barytes	Fine Grinding
Carborundum and emery	For paint base.

Extremely

Pigments in water	For manufacture of whiting.
Pigments in oil	For manufacture of colors.
Ink	For manufacture of oil paints.
	Incorporation of carbon and other materials in oil.

stands to reason that figures made up on the same basis for both methods will give comparative results.

Most engineers in figuring costs do not include all the items mentioned, especially that of "delays." This item is of considerable importance and one of the most difficult to figure. Some operators object to this from the

TABLE II. ESTIMATED COST OF GRINDING

Modern Type of Equipment	Old Type of Equipment
Power: 90-hp. at 2c. per kw.-hr.	Power: 150-hp. at 2c. per kw.-hr.
Hp. \times cost per hp.-hr.	
$\frac{90 \times 2 \times 0.746}{15} =$	$\frac{150 \times 2 \times 0.746}{15} =$
8.95c.	14.90c.
Labor: One man at 50% total time employed at 40c. per hr.	Labor: One man at 100% of total time employed at 40c. per hour.
Labor cost per hour	
$\frac{1.33c.}{15} =$	$\frac{2.66c.}{15} =$
0.089c.	0.178c.
Supplies: Wear of grinding media 1/5-lb. per ton. Cost laid down at plant 6c. per lb. Cost per ton equals $6 + 5 = 1.2c.$ per ton.	Supplies and Repairs: Assuming either old type of ball mill or high-speed pulverizer, average results show at least
Wear of lining 1/15-lb. per ton. Cost laid down at plant, 12c. per lb. Cost per ton equals $12 + 15 = 0.8c.$ per ton.	
Total, per ton.....	2.00c. Per ton.....
Repairs: Miscellaneous repairs, gears, bearings, etc. at \$800 per year. Assume 300 working days per year and 24 working hours per day.	Refer to above.
Cost per year in cents	
$\frac{800 \times 100}{24 \times 300 \times 15} =$	0.74c.
Delays: Time lost in breakage and delays, chargeable to mill at 6 days per year of 300 days. Cost of unground limestone \$1.50 per ton. Selling price of ground limestone \$3 per ton. All charges, except power and supplies, continue regardless of delays.	Delays: Time lost due to breakage and delays chargeable to mill, 20% of total possible operating time per year of 300 days. Worth of unground limestone \$1.50 per ton. Worth of ground limestone \$3 per ton. All charges, except power at 14.90c. per ton, continue regardless of shutdown.
Hours of time lost	
$\frac{300 \times 24 \times 100}{98} =$	Per cent of time lost, 20%.
Selling price of product less operating costs (exclusive of delays), less cost of unground limestone = Profit per ton.	
Difference between profit per ton and power and supply costs per ton, multiplied by % of time lost	
$\frac{300 - 16.11 - 150}{98} = 2.54c.$	$\frac{300 - 32.52 - 150}{98} = 117.48c.$
Profit = $300 - 16.11 - 150 = 133.89c.$ per ton.	Profit = $300 - 32.52 - 150 = 117.48c.$ per ton.
$(133.89 - 10.95) \times 2$	$(117.48 - 24.9) \times 20$
Cost = $\frac{98}{2.54c.} =$	$\frac{80}{23.10c.} =$
Interest on Investment: Cost of mill erected complete with all accessories, including freight, foundations, labor, etc. (but not building cost), \$20,000.	Interest on Investment: Cost of mill erected complete with all accessories (including freight, foundations, labor, etc.), but not building cost, \$20,000.
Cost \times interest rate per year	Cost \times interest rate per year
$\frac{20,000 \times 0.06 \times 100}{15 \times 24 \times 300} =$	$\frac{20,000 \times 0.06 \times 100}{15 \times 24 \times 300} =$
1.11c.	1.11c.
Depreciation: Cost as above \$20,000 at 8% per year.	Depreciation: Cost as above \$20,000 at 10% per year.
$20,000 \times 0.08 \times 100$	$20,000 \times 0.1 \times 100$
$15 \times 24 \times 300 =$	$15 \times 24 \times 300 =$
1.48c.	1.85c.
Miscellaneous: Oil, grease, etc.....	Miscellaneous: Oil, grease, etc.....
0.5c.	2.00c.

standpoint that they run their plant only twenty hours out of a 24-hour day, or if running on a 10-hour day basis, figure on getting their required capacity in eight hours and therefore this item would not enter into their calculations. Why do they figure on running only twenty hours out of twenty-four, or eight out of ten? Why not figure on running closer to the limit, thus increasing the capacity and enabling the plant to make more money, assuming, of course, that the other equipment in the plant, if any, is able to handle this increased

TABLE III. SUMMARY OF COMPARATIVE COSTS

Modern Type of Equipment	Old Type
Power.....	8.95c. 14.90c.
Labor.....	1.33c. 2.66c.
Supplies.....	2.00c. 2.66c.
Repairs.....	0.74c. 2.54c.
Delays.....	1.11c. 23.10c.
Interest on investment.....	1.11c. 1.11c.
Depreciation.....	1.48c. 1.85c.
Miscellaneous.....	0.5c. 2.00c.
Total cost per ton.....	18.65c. 55.62c.

capacity? Those who realize the value of continuity of operation have made provision for obtaining a definite capacity by installing spare equipment. This is certainly cheaper than running the old style of grinding equipment up to capacity, and the moment any mill is shut down the whole plant is retarded by the amount of loss in production in the grinding department. With modern equipment, there is no use in figuring on a large "factor of safety." Instead of running 80 per cent of the time, a unit will run 90 to 98 per cent of the time. Operators have been so accustomed for years to figure on a large percentage of lost time that they take this loss for granted. This condition was true in the mining industry a number of years ago, but of recent years the equipment has been so developed and standardized that 97 to 98 per cent running time for the grinding equipment is not unusual.

The value of the new method is readily appreciated when it is seen how long it would take to pay for the entire new installation out of the savings in the cost of grinding.

This is shown in Table IV.

TABLE IV. SAVINGS IN COST OF GRINDING

Total cost of installing new equipment.....	\$20,000.00
Scrap value of discarded old equipment.....	2,500.00
Net cost of new equipment.....	\$17,500.00
Grinding cost per ton of old system.....	0.5562
Grinding cost per ton of new system.....	0.1865
Saving in cost per ton over old system.....	0.3697
Saving per day = $0.3697 \times 15 \times 24$ or.....	\$133.20
Saving per year = 133.2×300 , or approximately.....	\$40,000.00
Time required to pay for new installation out of savings, due to decreased operating expense, $17,500 + 40,000 \times 12 = 3.25$ months.	

In other words, in one year's time the entire new installation is paid for with an additional net saving of approximately \$22,500. It is difficult to believe that such a saving is possible, but the figures are based upon concrete evidence, submitted by several managers and operators who have replaced old equipment with new.

There is absolutely no doubt that the time has come when the operator must be a specialist in his line and make a comprehensive study of conditions in his plant, just as the modern executive has evolved a simple method of keeping track of what is going on about him and has made a special study of the specific points of vital interest, in order to handle his business efficiently.

New York City.

Plastic Calcined Magnesite and Oxychloride Cements*

Physical Tests Showing and Factors Influencing the Properties of Oxychloride Cements — Suggested Specifications Include Reduction of Magnesia 97 per Cent Passing 100 Mesh and 75 Through 200 —Chloride Solution 22 Deg. Bé.—Initial Set From One to Eight Hours

BY M. Y. SEATON

THE magnesium oxychloride industry dates from the discovery by Sorel, in 1867, of the cementing action of a mixture of magnesium oxide and a solution of magnesium chloride. Sorel found that the cement produced was enormously strong and had very high binding power—that is, that it would allow of dilution with a very large quantity of aggregate and still produce a product of high strength. It was particularly noted that it would bind sawdust in satisfactory fashion to a hard, tough mass. This could not be accomplished by any of the usual cementing mediums known at that time.

The exact chemical constitution of Sorel's cement is still an open question. It seems probable that it is only partly a definite oxychloride, probably $3 \text{ MgO} \cdot \text{MgCl}_2 \cdot 10\text{H}_2\text{O}$, and that this is mixed with solid solutions of indefinite composition. Efforts to regulate the composition of a mix in such fashion as to keep the oxide-chloride ratio constant at that which holds for some particular oxychloride have not been reflected by any striking results from a strength or soundness standpoint.

The commercial possibilities of Sorel's cement were very soon recognized and within a comparatively few years after his invention the construction of floors composed of sawdust, wood flour and sometimes siliceous aggregate, cemented with magnesium oxychloride, became quite common in Germany and in France. Various difficulties in the preparation of satisfactory mixes were experienced, but the industry developed normally and later spread to this country. It is found possible to secure properties in a flooring using an oxychloride cement binder which cannot be obtained by the use of any other flooring material. The product accordingly has taken its place as a more or less standard building material. Oxychloride, or, as they are commonly called, "composition" floorings require highly skilled workmanship in their application, but numerous organizations are now in a position to lay such floors. The development of exterior stuccos in which magnesium oxychloride is the binding medium is more recent. Sorel's original statements as to the waterproofness of his cement have not been entirely confirmed and there was for a long time a real doubt as to the permanence of such stuccos. Experience has shown, however, that, provided the raw materials are of proper quality and are properly mixed, a sound and permanent stucco will result.

In the preparation of any oxychloride cement, three classes of raw materials are required: aggregates, magnesium chloride, and magnesium oxide. The aggregates employed include sand, ground sand or silex, marble or limestone dust, talc, china clay, sawdust and

wood flours of various grades, asbestos fiber, and pulverized cork. The fineness and the percentage of voids in sand, the fineness of the various fine fillers, the type of wood and the particle size of wood flours and sawdust, the fiber length of asbestos, and the fineness of granulated cork give indications as to their value. The magnesium chloride employed is recovered from natural brines or salts in the Stassfurt district, or from Michigan, Utah or California in this country. The usual product is either a solid or granular material containing in the neighborhood of 98 per cent $\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$ and less than 2 per cent of calcium chloride, of magnesium sulphate, or of sodium chloride. Chemical analysis clearly indicates its quality. The magnesium oxide required is essentially all prepared from natural magnesite, large deposits of which occur in Greece, Austria, Venezuela and in the states of Nevada, Washington and California. The term "plastic calcined magnesite" is in a sense a misnomer. Magnesite after being calcined is obviously no longer magnesite, but is magnesium oxide or magnesia. Inasmuch as the magnesium oxide used by the oxychloride industry is generally prepared by the heating of natural magnesite rock, the term has gained such standing with consumers that it will be used unchanged throughout this paper. "Plastic magnesia" or "caustic magnesia" are occasionally employed in the same sense. The testing of this product has proved one of the most troublesome points encountered by producers of oxychloride cements.

PHYSICAL TESTS OF OXYCHLORIDE CEMENTS

It is obvious, of course, that the value of any plastic calcined magnesite lies in its ability to form sound, strong and permanent oxychloride cements when used in proper mixtures and that only tests which are indicative of its ability to fulfil this function will throw light on its quality. We must consider first, then, the question of physical tests of oxychloride cements.

Selection of a standard testing mix for oxychloride cement investigations is rather troublesome. Entirely unsatisfactory results have been obtained by attempting to test mortars containing only sand as an aggregate, that is, by following the general practice used in testing portland cement. The reason for the trouble is not far to seek. The mortars and the concretes used in portland cement tests approximate in composition mixes used in the field. It is quite rare for a commercial oxychloride cement to contain only sand as an aggregate, or at least only sand of the character of the sands usually used in cement testing. The usual oxychloride stucco is either prepared from an excessively fine sand or contains a considerable amount of fine aggregate, most commonly ground silica or silex. It is found, in fact, that best results can be obtained only

*Read before the American Society for Testing Materials, Asbury Park, N. J., June 22, 1921.

when such a fine aggregate is used in an oxychloride mix. An elaborate series of investigations has indicated that most concordant test results are obtained in a mix which contains as high as two parts of silex to five of sand. Such a mix requires the use of only a comparatively small amount of calcined magnesite, 12½ per cent of the total mix being sufficient. The standard testing mix referred to throughout the remainder of the paper will be one containing one part calcined magnesite, two of silex—the material known commercially as 120-mesh silex being used—and five of standard Ottawa sand. When the question of adoption of a standard floor mix is considered, even more difficulty is encountered. So many different types of floors are laid, varying from soft and resilient to hard and stonelike, that any one mix will represent but a comparatively small proportion of the total actual installations. There are definite relations between the results obtained on flooring and on stucco mixes when used with various magnesites, so we will consider at length only tests on the standard stucco mix.

The data necessary for determination of quality of an oxychloride cement can be obtained from tests for strength, volume change, setting time and permanence of the product.

STRENGTH TESTS

Four types of strength tests have been studied—namely, tensile, compressive and cross-bending strengths, and resistance to abrasion. No particular comment is needed on tests for tensile or for compressive strengths. The ordinary standard size briquet for tensile tests and the usual cubes or cylinders employed for mortar compression tests can be used to good advantage. Such tests, although throwing much light on the properties of oxychloride cements, sometimes do not check field results. It should be recognized that oxychloride products are used at present only as comparatively thin surface coatings, never being employed in mass work of any type. Neither briquets nor compression cubes or cylinders can be aged under conditions comparable with the aging of such thin coats of flooring or stucco. Especially during the early life of the cement, contact with air exerts a considerable influence on its rate of gain of strength.

It has been considered important, accordingly, to work mainly with test specimens approximating in shape a section from the coatings as applied in practice. Excellent results have been secured from flat bars ½ in. thick, 2 in. wide and 24 in. long. These bars can readily be prepared in suitable steel molds and, after proper aging, can be tested in a simple cross-bending machine in which the load is applied by running shot into a cup supported on the bar. An ordinary plasterers' trowel is used in preparing the test specimens and the influence of various methods of troweling can be readily studied. Flat bars of this type, besides more closely approximating field aging conditions for stucco or flooring mixes, allow also of determination of modulus of elasticity and of the making of water resistance tests, which latter cannot be conveniently made on other forms of specimen.

For flooring mixes, there is no inherent reason to suppose that a direct relation between tensile strength and resistance to abrasion need exist. Some interesting data on the abrasion resistance of various composition floors have been obtained by rotating a set of steel cubes weighing about 5,000 g. over the

surface of the floor while a slow stream of fine silex is fed onto the surface to serve as abrasive material. The depth of the impression in the floor is readily obtained from a small measuring bridge supported on points outside the abraded area by which a map of the floor surface can be drawn.

VOLUME CHANGE

The volume change, or more exactly, the linear expansion or contraction of a test specimen, is of decided importance in a study of oxychloride cement quality. Two methods for the measurement of this property have been considered. One consists in the preparation of bars 1 in. square and 10 in. long, which have metal plates imbedded in their ends. These bars can be removed from the molds at about the period of final set and measured by a large micrometer. Such bars, however, do not allow of determination of change in length during the early ages of the material—that is, during the period before final set—as they are too weak to be handled at such a time. Inasmuch as a certain amount of difficulty with cracking of stucco and of flooring mixtures has been encountered during this early period, somewhat more satisfactory results have been obtained by measurement with the Berry strain gage of the movement of reference points inserted in a ½-in. bar of stucco or flooring mix which is formed on a sheet of waxed paper and need not be disturbed during testing. Such measurements can be begun at the period of initial set.

SETTING TIME

Setting time of oxychloride mixes can be determined by the usual Vicat or Gillmore needles. Certain complications are introduced by the fact that mixes containing aggregate must be tested. The results on neat mixes of calcined magnesite and magnesium chloride solution are not found to be comparable with results obtained from the use of the same magnesite in the usual flooring or stucco composition. Some difficulty in determining definitely the end point of setting time may be encountered on account of the presence of sand in the mixes being tested, but determinations are still fairly accurate. Where a large number of determinations are to be made, the Hill setting-time machine, which automatically raises and lowers a set of Gillmore needles onto an extremely slowly moving pat of the oxychloride mix, has been found to give good results. With a known rate of movement of the pat, setting time can be determined by measuring the length of the series of impressions from each needle.

PERMANENCE

Inasmuch as all oxychloride products are submitted to periodic wetting either from the weather, in case of a stucco, or from scrubbing, in case of a flooring, some data on water resistance of oxychloride mixes are of value. The flat bars mentioned above allow of making a water test comparatively easily. They can be placed behind a perforated grid which protects their backs from direct contact with water and sprayed with a gentle mist of water directed against their faces. Strength can be determined after various periods of wetting and of subsequent drying. A satisfactory water test has been found to consist of spraying 14-day-old bars for three successive 24-hr. periods with 24-hr. drying periods intervening, finally testing the bars wet and after two days' additional drying in comparison with the usual test on an unsprayed bar.

Various factors will influence the value of the test results obtained by any of the methods noted above.

Consistency of the mortar will influence strength in the same direction in which consistency variation influences strength of portland cement mortars. The effect is very much less marked, however. With portland cement mortars, an increase in consistency from normal to 125 per cent of normal gives a lowering in strength to about 65 per cent of normal. A similar increase in consistency of an oxychloride cement mortar gives a decrease in strength of 93 per cent of normal. There is not as great danger, accordingly, of poor results being obtained from excessive addition of chloride solution with oxychloride cements as there is from the use of too much water with portland cement. On this account, too, the usual schemes of definition of aggregate quality which depend directly or indirectly on the amount of water required to make a plastic mix with the aggregate in question entirely fail when applied to oxychloride cement mixes.

The strength of the magnesium chloride solution has great influence on the properties of oxychloride cement. Fig. 1 gives the results obtained from an average oxychloride stucco mix by increasing the strength of magnesium chloride solution progressively. It is seen that satisfactory results cannot be expected from dilute chloride solutions. The curves might indicate that better cements would be obtained as the specific gravity of the chloride solution was increased to a very high point. Other factors, however, must be studied before such a step can be considered. With chloride solution strengths above 24 deg. Bé., undue expansion effects develop. The optimum concentration of the magnesium chloride solution appears to lie at 22 deg. Bé. A certain amount of field work is done with chloride solutions of from 18 to 20 deg. Bé., but the slight saving in magnesium chloride effected by this practice cannot be justified in view of the decided advantage to be gained by the use of somewhat stronger chloride. The reason for the use of weak chloride is frequently said to be the fact that such chloride solutions will make an oxychloride cement which sets slower. This is entirely opposed to the results found from determination of setting time of a series of mixes in which

chloride strength is varied. From the practical man's standpoint setting time of an oxychloride stucco is of interest inasmuch as it influences the behavior of the stucco when dry pebble dash is applied to it. A material which sets too fast resists the penetration of the pebbles. Careful tests have shown that although there is a slight difference in favor of a stucco prepared with weak chloride when the question of dash penetration is considered, this difference is only in the neighborhood of 10 per cent, an amount which is not observable in actual practice.

INFLUENCE OF THE CHARACTER OF THE AGGREGATE

The character of the aggregate influences the various properties of an oxychloride cement in a rather complex way, and the question can no more be covered in a short space than can that of the study of aggregates for use in portland cement concretes. In general it may be said that the use of fine aggregate is essential for the attainment of high strengths and good water resistance. The mechanism of the setting reaction with oxychloride cement is quite different than with portland cement. When portland cement sets, the small particles surround themselves with a shell of reaction product, but the center of each cement particle remains unchanged. In a sense, then, portland cement furnishes its own fine aggregate. With oxychloride cements, provided the calcined magnesite is reasonably finely ground, each particle of magnesium oxide completely enters into reaction. If the reaction product is called on to fill the comparatively large voids between sand grains, a mass of inferior strength will result.

However, if a fine aggregate is introduced which will itself enter the voids between sand grains, the oxychloride cement will need only to coat these particles of fine aggregate and to fill the much smaller voids which would result and much higher strengths and permanence will be secured. Here, as in the case of portland cement mortars or concretes, the cementing material is the weakest portion of the set mass and if it can be reduced to a minimum, the physical properties resulting will be more desirable. When very fine magnesites are employed, the amount required for production of strong cements can be reduced to a surprisingly low figure, 4 or 5 per cent only being required in a mixture in which the coarsest aggregate is a comparatively fine sand. If an oxychloride concrete were to be formed, the amount needed would be still smaller.

Curves giving strength of mixtures of various composition, in all of which the same magnesite and same strength of chloride solution were used, are given in Fig. 2. They indicate strikingly the advisability of the addition of fine aggregate. It should be noted that the influence of fine aggregate on wet strength is even greater than on dry strength. Mixes without fine aggregate often disintegrate completely on wetting.

Storage conditions during the aging of oxychloride test specimens of any type must be carefully regulated. Storage in air is always employed. The temperature must not vary more than 10 deg. F. from a standard of 70 deg. F. and humidity not over 15 per cent from a standard of 50 per cent relative humidity if concordant results are expected. High temperature or low humidity increases rate of gain of strength and greatly accelerates setting; low temperature and high humidity have the reverse effect.

The quality of commercial calcined magnesite exerts

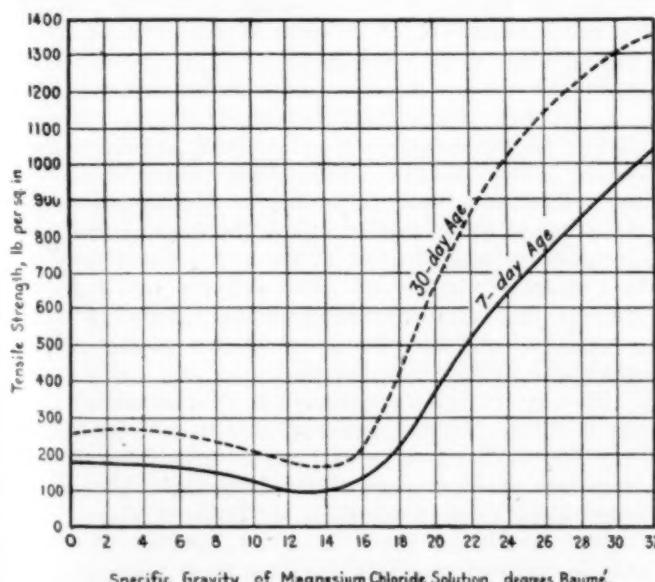


FIG. 1. RELATION BETWEEN SPECIFIC GRAVITY OF CHLORIDE SOLUTION AND TENSILE STRENGTH OF 1:2:5 OXYCHLORIDE MIX

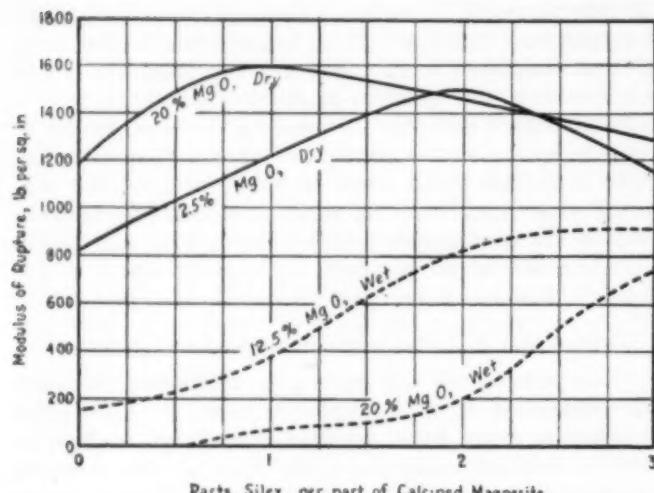


FIG. 2. STRENGTH AT 14 DAYS OF OXYCHLORIDE MIXES CONTAINING CALCINED MAGNESITE, SILEX, AND SAND

Ratio of silex to sand varied, but MgO content of each mix held constant.

a tremendous influence on the properties of oxychloride cements. Certain magnesites appear on the market which will not give a satisfactory product no matter what attention be paid to other details of mix composition. The usual tests of magnesite quality which have been applied in the past have consisted of a chemical analysis of the calcined product. In general, limits for ignition loss, calcium oxide, silica and magnesium oxide have been written into specifications. Users of this product have come to realize during the past few years, however, that their chemical analysis specifications were not insuring them a magnesite of high quality. Some results which bear out this point are shown in Table I.

Study of several hundred commercial magnesites has indicated that there is only one factor determinable by chemical test which exerts a definite influence on the character of the cement. This is the percentage of the active lime. The amount of this constituent present bears no relation to the content of total lime in the magnesium oxide. Active lime can be determined by agitation with dilute magnesium chloride solution and determination of the amount of calcium chloride introduced into the solution. Unfortunately, it is found that the relation between strength, permanency and active lime content is traceable only when average figures covering many magnesites are examined. Other factors play so important a part in regulating oxychloride cement strength that the relation does not appear when test results on individual samples are examined.

The explanation of the wide discrepancy between chemical analysis and physical test results is found in the fact that the time-temperature history of the calcining procedure is of vital influence on the reaction between magnesium oxide and magnesium chloride, although it is not reflected in any major change in analysis. Widely varying results can be secured from samples of calcined magnesite from the same rock.

SUGGESTED SPECIFICATIONS

Fairly satisfactory results can be obtained in study of magnesite quality if reliance be placed on purely physical tests. A determination of fineness is unquestionably of value. At least 97 per cent of the material should pass a 100-mesh screen and at least 75 per cent

TABLE I. COMPARISON OF CHEMICAL ANALYSIS OF CALCINED MAGNESITES AND PHYSICAL PROPERTIES OF OXYCHLORIDE CEMENTS

Mag- nesite Loss No. on I : 2 : 5 Mix. 22 Deg. Baumé Chloride	Chemical Analysis, per Cent					Setting Time Hr. and Min. Initial Final	Dry	Wet	Modulus of Rupture, Lb. per Sq. In.	Re- cov.
	Ignition CO ₂	SiO ₂	R ₂ O ₃	CaO	MgO					
1... 9.20	4.05	9.58	0.95	7.50	73.7	2:15	3:00	1,500	828	1,218
2... 6.05	4.20	17.7	4.50	11.10	60.6	2:00	6:00	1,362	654	1,374
3... 8.35	3.25	5.07	0.80	3.58	82.0	2:30	4:30	1,232	642	977
4... 6.98	1.68	7.01	0.42	3.64	82.8	3:45	4:30	1,010	618	854
5... 10.65	4.07	8.09	1.32	4.34	75.6	2:15	4:00	1,277	594	1,188
6... 7.91	2.08	1.41	0.59	2.44	87.6	2:15	4:00	1,580	525	967
7... 9.09	1.54	2.09	1.20	3.40	85.0	3:45	6:00	1,486	273	605
8... 8.69	3.44	13.34	2.03	4.28	71.6	2:30	3:30	1,011	232	810
9... 2.95	2.80	3.45	0.88	4.48	88.2	2:30	3:30	1,604	132	198
10... 6.95	2.54	7.65	1.21	3.75	80.5	2:00	4:00	1,378	97	300

a 200-mesh screen. Calcined magnesite is a comparatively easy material to grind and it is very probable that this fineness can be greatly increased and quality accordingly improved without introducing serious manufacturing difficulties. Coarse magnesite results in abnormal expansion of the cements prepared from it. The magnesite, if of satisfactory fineness, should be used in a standard oxychloride mix, preferably the one magnesite, two silex, five sand composition previously mentioned, and further tests carried out on this material. The specific gravity of the chloride solution used should be 22 deg. Bé.

The plastic oxychloride mortar should not show initial set within an hour. It should attain final set within eight hours. A 2-hr. minimum for initial set is preferred by some workers while some will consider the 8-hr. maximum for final set unduly long. The first limits, however, are about those met by average commercial calcined magnesite. Modulus of rupture on the flat bars previously described should be at least 550 lb. per sq.in. at one day and at least 1,000 lb. per sq.in. at seven days.¹ Oxychloride cements from average magnesites will give figures much higher than these. Limits on expansion and contraction are exceedingly difficult to set but it is probable that a magnesite which shows over 0.3 per cent contraction or expansion within twenty-four hours after initial set in the mix specified should be considered as of questionable quality. Limits for water resistance are also hard to set. Unless the oxychloride cement made from a particular magnesite shows a wet strength after the standard spraying procedure of at least 30 per cent of its dry strength, however, some doubt as to magnesite quality should be felt.

A calcined magnesite which meets the requirements suggested will certainly be of at least average quality. Much better material than that indicated can be secured when greater attention to the preparation of the calcined product is given by the various producers. Co-operative work is now under way which should lead to the establishment of more definite limits for the various factors discussed, probably resulting in the issuance of definite specifications for plastic calcined magnesite within a year or so.

The oxychloride industry is one of remarkable latent possibilities. It has suffered seriously from lack of attention to the quality of the raw materials used and from lack of knowledge of the basic principles of mix preparation. As more data on both of these points become available, there is little question that oxychloride cement products will take their place as standard construction materials for certain definite uses.

¹On $\frac{1}{2}$ -in. bars, broken on 20-in. centers, the modulus of rupture will average 2.2 times the tensile strength.

Hardwood-Distillation Industry—III

Discussion of the Problems Encountered in the Separation of Commercial Products From the Mixtures of Wood Distillates and of the Difficulties Encountered in the Distillation of Sawdust*

BY L. F. HAWLEY†

THE problem of obtaining commercial products from the mixtures of wood distillates is usually taken up from the standpoint of producing especially acetate of lime and methanol from the pyroligneous acid and of separating the different oils contained in the tar.

It has been stated previously (p. 197) that the wood distillates when condensed give two crude products—namely, pyroligneous acid and tar—that gravity and solubility are not sufficient for their complete separation, that some constituents of the tar are found in the pyroligneous acid and *vice versa* and that their complete separation can be realized only by fractional distillation. The first operations, therefore, are the separation of the tarry material from the pyroligneous acid and the freeing of the methanol and acetic acid from the settled tar. If the tar is to be distilled in a fire still, the removal of the acid and methanol is made a part of that process, otherwise a steam distillation only is used.

The first apparatus used in refining the mixtures of wood distillates were fire stills heated by the direct heat from a firebox underneath. These stills required very careful control, and only workmen with considerable experience were able to obtain good results with them or even to operate them with safety. All of the stills used in the refining process, except the fire stills for tar, are now heated by steam coils, which are much easier to regulate and which give better results due to less superheating of the product.

PRODUCTS OBTAINED BY WOOD TAR DISTILLATION

On distillation the wood tar may be separated into products of considerable difference in their chemical and physical properties.

The first parts of the distillate, the light oils with boiling points up to 200 deg. C., have specific gravities less than unity and contain practically no phenols. These light oils are very complex and have been studied chemically by G. S. Fraps,¹¹ who investigated a commercial "wood oil" to determine its prominent chemical constituents. Fraps found that this oil contained a series of aldehydes, ketones and acids of the formaldehyde, acetone and acetic acid series respectively, the acids occurring mostly in the form of methyl esters. These constituents, however, are only the more active ones, and the less active compounds, apparently complex hydrocarbons, were not studied. No exact quantitative determinations were made, and the compounds identified probably constituted only a small proportion of the total oil.

* For Parts I and II see *CHEM. & MET. ENG.*, vol. 25, Nos. 4 and 5, July 27 and Aug. 3, 1921, pp. 137 and 195.

† In charge Section of Derived Products, Forest Products Laboratory, U. S. Forest Service, Madison, Wis.

¹¹ *Am. Chem. J.*, vol. 25, p. 26 (1901).

The heavy oils from wood tar have also been studied in some detail, but only the phenolic bodies soluble in alkali have been identified. About sixteen phenolic bodies with boiling points between 178 and 285 deg. C. have been detected, but no figures have been given in regard to the percentage composition. It is noticeable that all these compounds are either straight phenols or methyl ethers of phenols. Although phenol itself and the cresols have been detected in wood tar, these occur only in very small quantities, the high-gravity and high-boiling methyl ethers being the main constituents. This is one respect in which hardwood tar differs from coal tar—namely, that phenol and the cresols are not present in considerable quantities.

Benzene and xylene have been reported as occurring in hardwood tar or tar oils; but although they may be present in small quantities, they are not of commercial importance.

That part of the heavy oils which is insoluble in alkali has never been studied, and there is no information available in regard to its probable composition. It does not, however, contain naphthalene or anthracene in appreciable quantities like the coal tars.

The residual pitch has never been studied from the chemical standpoint, but from its general properties it must be very complex chemically. A hard or soft pitch can be obtained, depending on the amount of heavy oils left undistilled in the pitch.

When distilling with steam a product known in the market as "wood oil" is obtained. This oil naturally varies with the amount of steam used in the distillation, but practically always contains all of the light oils previously mentioned, and in many cases considerable quantities of the heavy oils with boiling points above 200 are also included.

USES FOR WOOD TAR DISTILLATION PRODUCTS

From the discussion of the composition of the tar it can be seen that numerous different products could be made by variations in the method of separating, redistilling and drying the fractions of tar oils.

The light oils are a very good solvent for some purposes; the heavy oils are valuable for stains, disinfectants and preservatives, or as a raw material for the manufacture of beech-wood creosote; and the pitch has been used as a waterproofing and insulating material. Various combinations of light and heavy oils and pitch have been used for flotation oils, and this is the one general use to which hardwood tar and tar products seem to be especially adapted.

The distillation of hardwood tar in fire stills is a comparatively new process, but it has been very successful and there is a chance here for an increase in the value and number of hardwood-distillation products.



ACETATE DRYING FLOOR OVER THE OVENS

The pyroligneous acid freed of the tar it contained is neutralized with lime in order to form a non-volatile acetic acid compound from which the volatile methanol can be separated completely by distillation. After this neutralization the pyroligneous acid turns very dark, and non-volatile impurities are formed which contaminate the acetate of lime. The methanol is removed by distillation and the impure solution of acetate of lime remains behind. This impure solution is evaporated and dried to the commercial product called "gray acetate of lime."

Until within a few years some crude pyroligneous acid was used directly, when, after neutralization with lime, evaporation and drying, a product containing tarry impurities was obtained known as "brown acetate of lime."

As calcium acetate is more soluble in cold water than in hot, it is not possible to crystallize this salt by the usual methods. The impurities present also prevent the formation of good crystals on drying, and the finished material resembles a gray granular powder without crystal form.

There are many fine points in the neutralization of the distilled pyroligneous acid with lime which have never been properly studied. In commercial practice the neutralization is usually carried to a point which gives the best acetate of lime. If the neutralization is carried farther or not so far, difficulty is found in preparing a granular acetate, since there is a tendency for the material to separate out in a hard crust on the bottom of the evaporating pan instead of forming the usual granular crust on the surface of the liquid.

Since the pyroligneous acid contains both acetic acid and methanol, it must also contain a definite proportion of methyl acetate according to the equilibrium between the quantities of water, methanol and acid present. When the pyroligneous acid is neutralized, the methyl acetate is hydrolyzed to methanol and acid, but this takes place slowly and in most cases there are considerable amounts of methyl acetate still undecomposed in the distillate. This slow hydrolysis accounts for the fact that completely neutralized pyroligneous acid will become acid again on standing.

It might be possible to obtain slightly higher yields of methanol and acetic acid by making sure that the hydrolysis is complete before distilling the neutralized liquor, but if this must be done at the expense of difficulties with the quality of the acetate it is not considered to be worth the effort.

ACETATE SLUDGE

When the distilled pyroligneous acid is neutralized with lime, a considerable quantity of insoluble material settles out at the bottom of the tank. This so-called acetate sludge contains insoluble impurities from the lime and also insoluble organic compounds precipitated or polymerized by the neutralization of the liquid. This sludge was formerly settled out from the acetate liquor and thrown away without any serious attempt to wash it. It was soon found, however, that appreciable amounts of acetate of lime were being lost with the sludge, and various methods of washing have now been introduced. In some of the larger plants mechanical filters of different kinds are now used to remove the last traces of acetate from the sludge.

EFFICIENCY IN THE USE OF THE HEAT REQUIRED FOR REFINING

Since the refining of the hardwood-distillation liquors consists normally of several redistillations of the ordinary crude liquor, there is a chance to save considerable steam by the use of the principle of multiple-effect evaporation or in the use of exhaust steam for evaporating at reduced pressure. The multiple-effect principle has been applied in several ways. Triple-effect evaporators have been used on the green liquor or crude pyroligneous acid and also on the neutralized acetate liquor. A double-effect evaporation has been obtained by using one evaporator heated by steam for distilling the crude pyroligneous acid and then using the vapors from this evaporator for heating the acetate liquor in another evaporator.

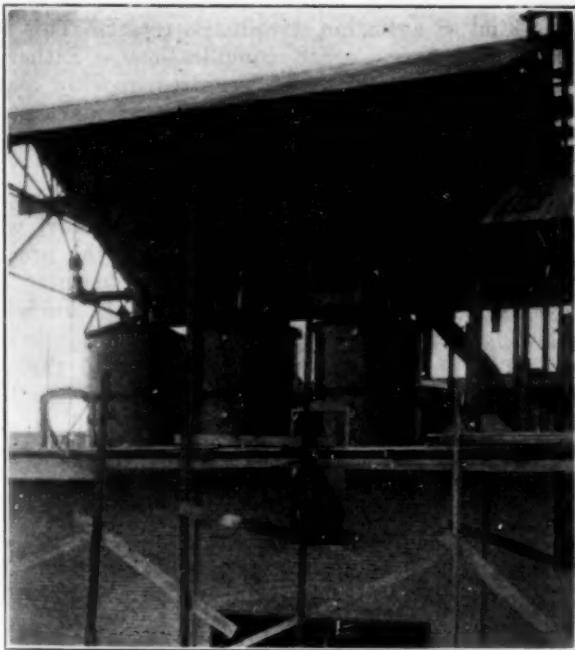
Various types of evaporators have been used, and we have recently seen in operation some Klar evaporators of the German type installed by Klar ten or twelve years ago, aremba evaporators of copper with vertical tubes for use on the pyroligneous acid, Zaremba iron evaporators with horizontal tubes for use on acetate liquor, Buffalo Foundry & Machine Co.'s inclined-tube triple-effects and Badger evaporators for the double-effect combination in which the vapors from the pyroligneous acid are used to heat the acetate liquor.

DIFFICULTIES ENCOUNTERED IN THE USE OF EVAPORATORS

Varying results have been obtained, but the common objection to evaporators is the difficulty caused by the deposition of some form of tar either inside or outside the evaporator tubes. In one place the first-effect evaporator in which the crude pyroligneous acid was distilled gave a great deal of difficulty by the deposit of tar or pitch on the outside of the tubes. This, however, was finally avoided by allowing a part of the settled tar to flow into the evaporator along with the pyroligneous acid, the oils in the tar apparently dissolving the pitch from the tubes. In other cases, however, the crude pyroligneous acid has been evaporated without the presence of the settled tar and it is claimed that no difficulty has been encountered in fouling the tubes. In some places where there is no difficulty in the first-effect the vapors carrying over from this effect

seem to form a deposit on the inside of the tubes of the second-effect, and considerable trouble has been caused in this way. There seems to be no general agreement on the subject of the difficulties of tar deposition and how they may be best avoided, but it seems to be the general rule that evaporators working on wood-distillation products must be so constructed that the tubes both inside and outside can be readily cleaned.

When multiple-effect evaporators are operated at all efficiently there is a great saving of steam over the ordinary evaporation processes. It must be remembered, however, that the ordinary copper still is much simpler in construction and operation and is cheaper than the multiple-effect evaporator, and in cases where the cost of fuel is not high these points may make up the difference in steam efficiency. In one place a single-effect evaporator was in use on the crude pyroligneous acid and was heated entirely by exhaust steam. This evaporator was being used in place of four of the



MULTIPLE-EFFECT EVAPORATORS

ordinary copper stills which required pressure steam for their operation. This gives a good example of the possibility of steam economy in the refining of wood-distillation products.

SEPARATION OF THE METHANOL

Formerly the separation of the methanol from the neutralized pyroligneous acid was accomplished by continued redistillation in a series of ordinary pot stills without any kind of fractionating column. The first fractionating devices used in connection with this operation were the so-called Burcey pans, by which a certain amount of dephlegmation and fractional condensation were obtained. These Burcey pans were in use in most of the crude plants and were efficient enough, so that little difficulty was encountered in obtaining most of the methanol from the crude liquor in the form of crude 80 per cent methanol in one or two distillations. Column stills have replaced the Burcey pans in many plants with considerably increased efficiency, but a few of them are still in operation.

In places where triple-effect evaporators are used, the neutralized acetate liquor is usually run through a

continuous column still for the removal of the crude methanol before the liquor is run through the evaporators.

The use of column stills, particularly continuous stills, in concentrating the methanol is more efficient than the usual method of distilling the neutralized liquor in a lime-lee still and then concentrating the distillate from this still.

Continuous stills for the removal of the alcohol from the neutralized liquor are coming more and more into use and apparently give very satisfactory service.

In some places deposits of tar or pitch are formed in certain sections of these stills, but they do not often have to be stopped for the purpose of cleaning.

EFFECT OF THE PRESENCE OF METHYL ACETATE IN THE METHANOL LIQUOR

The effect of the presence of methyl acetate in the methanol liquor is of some importance on account of its effect on the determination of the percentage of methanol, which is always made by specific-gravity methods. Methyl acetate has a very high gravity in comparison with methanol, although its gravity is slightly less than that of water. On this account, if large quantities of methyl acetate are present, the determination of the value of the methanol by gravity is not correct, since the methyl acetate is not determined in proper proportion by gravity determination. Methyl acetate persists in the refining operations and is found in the final products of the separation of methanol.

BETTER QUALITY OF METHANOL

The quality of the refined methanol has gradually increased as demands were made for a better product and as experience in refining increased. The first refined methanols were of very poor quality, having considerable color and a very disagreeable odor. Since this product was used largely as a solvent, it was not necessary to prepare a pure alcohol, and although the color and odor were gradually improved, considerable quantities of acetone still remained in the refined alcohol. This is due to the fact that methanol forms with acetone a constant boiling mixture which cannot be separated by the most careful fractional distillation methods.¹² Fortunately, however, this constant boiling mixture has a high proportion of acetone which makes it possible to obtain by commercial distillation a very pure methanol, although the acetone separated from it contains also considerable quantities of methanol. Methyl acetate forms similar constant boiling mixtures with both methanol and acetone.¹³ At the present time, methyl alcohol without color or disagreeable odor and with only traces of acetone is produced in large quantities.

It may be desirable at this point to call attention to an error which constantly occurs in the literature on wood-distillation processes. A series of compilers, who have obtained their information from the printed page instead of from laboratory or plant, have handed down from one to another the tradition that acetone is separated from methanol in commercial refining plants by chemical methods. The methods mentioned are usually the formation of chlorine addition products of the acetone or the formation of a compound of calcium chloride with methanol from which the acetone can be removed by distillation. Although Klar, in 1910, was

¹²Haywood, *J. Phys. Chem.*, vol. 3, p. 349 (1899).
¹³Ryland, *Am. Chem. J.*, vol. 22, p. 384 (1899).

very emphatic in denying that these processes were then used commercially or had been used for years, occasionally one of these chemical methods for refining methanol will be mentioned in the literature as a modern commercial method.

EVAPORATION AND DRYING OF ACETATE OF LIME

The common method of handling the acetate liquor, after the methanol has been distilled from it, is to evaporate in shallow, steam-heated, iron pans and then dry the thick residue from these pans on the drying floor built on top of the retorts. In the case of the kiln plants this drying floor was especially built for heating by waste heat or by a special firebox. This process required pressure steam in the evaporating pan and considerable labor in operating the pans and in raking the acetate on the drying floor.

New methods have been introduced and are in common use in certain localities for evaporating and drying this acetate liquor in automatic apparatus requiring very little labor. The acetate liquor concentrated by some other method to a point very near the separation point is run into a shallow pan in which a steam-heated steel roll revolves, dipping into the concentrated acetate solution for a few inches on its lower surface. A series of scrapers, automatically controlled, scrape the partly dried acetate from the surface of the roll and drop it into the conveyor. The amount of moisture left in the acetate when it is scraped from the roll is regulated by the speed of revolution, by the steam pressure and by the number of times which the surface of the roll is scraped per revolution. Generally the acetate comes from this roll in the form of a thick mud, and this mud is further dried by being picked up on an endless wire belt and squeezed in between the links and between the upper and lower surfaces of the belt. The belt carrying the acetate mud then travels through a drier heated by steam or by some form of waste heat until the acetate is completely dried. It is then automatically removed from the belt by making the belt turn sharp corners to crack the lumps of acetate and by automatic tapping which shakes out the remaining fragments of dried acetate. In this way the acetate liquor is concentrated and dried and the finished acetate of lime dropped onto conveyors and carried to a storage bin without the necessity for any handling.

DESTRUCTIVE DISTILLATION OF SAWDUST

Many publications on wood-distillation have described in some detail commercial methods for the destructive distillation of sawdust. The Halliday method is the

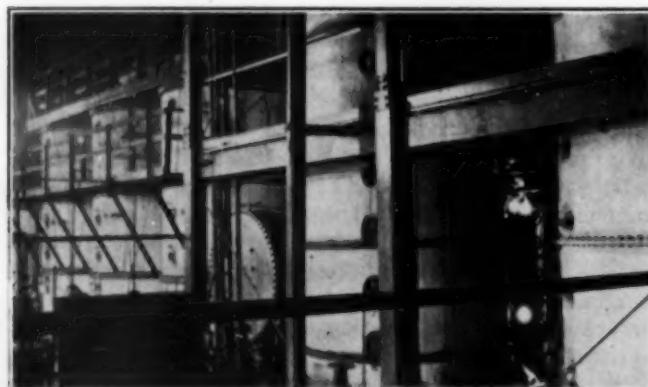
one most commonly described, and the picture of this apparatus has become familiar. It is, therefore, a fairly common impression that the destructive distillation of sawdust has been in commercial practice for many years. We are certain that until very recently no commercial process of sawdust distillation had ever been in operation in this country, and according to Klar's book published in 1910 no sawdust-distillation process had been in successful operation anywhere up to that time.

There are many difficulties in the way of successful destructive distillation of sawdust. In the first place, wood itself is a good non-conductor of heat and sawdust is even better in this respect, since a mass of sawdust contains many closed air spaces which are still better non-conductors. A stationary mass of sawdust is, therefore, very difficult to distill, since it is almost impossible for the heat required to pass through to the center of the mass. It is necessary, therefore, that the sawdust be stirred either by a rotating retort or by some kind of agitation within the retort. This immediately introduces other complications. Either a stirrer or a rotating retort requires moving parts which must be joined gas-tight to the stationary parts of the retort, and at the temperatures of destructive distillation this is not a simple problem. The agitation of the mass also stirs up a great deal of fine charcoal dust, which tends to be carried out of the retort with the vapors and to clog the condensers. If the process is to be continuous, it is also necessary to introduce the sawdust without introducing too much air and without allowing any of the products of the distillation to escape. The charcoal must also be removed through some kind of a gas-tight seal. The cooling and handling of large quantities of finely divided charcoal is also a problem which has not yet been solved; and this, together with the marketing of large quantities of such a product, again adds to the difficulties of sawdust distillation. Several methods for solving these problems have recently been suggested, and some of them have been carried out in commercial or semi-commercial units.

THE BRIQUETTING PROCESS

The American Wood Reduction Co. avoided many of the problems in connection with sawdust-distillation by making the sawdust into a solid block of wood before distillation. In other words, the sawdust or very small-sized wood was briquetted and distilled in the form of briquets. When sufficient pressure is applied to wood a very solid briquet can be formed without the use of any binding material. These briquets, however, when made of hard wood, tend to fall to pieces during destructive distillation; consequently the benefits of briquetting would be largely lost. It was found, however, that, if these sawdust briquets could be subjected to slight mechanical pressure during the distillation, they remained in one piece and fairly firm, regularly shaped pieces of charcoal could be made by this method.

The process finally developed by this company included the conversion of the waste wood in the form of sawdust or small chips into 4-in. briquets, which were loaded from an automatic loader into retorts, consisting of a series of horizontal tubes 20 ft. long and with an inside diameter slightly greater than that of the briquets. Each of these tubes was provided with a piston, by means of which a small pressure of 8 or 10 lb. per sq.in. could be exerted continuously against the column



ACID LIQUOR EVAPORATORS AND CONTINUOUS METHANOL STILL

of briquets during the distillation. On account of the small diameter of the tubes, each of which really acted as a single retort, the complete distillation could be finished in about three hours, and the temperature control was good enough so that unusually high yields were obtained. The cost of preparing the wood for distillation and the rather complicated and small-capacity apparatus was, therefore, compensated by the high yields and short length of time in the retort. A plant to use this process was under construction for the Bureau of Aircraft Construction during the war, and was about 80 per cent completed at the time of the armistice. This plant was never put into operation, and the process never had a trial on a commercial scale.

THE SAWTELLE PROCESS

The Sawtelle process also avoided some of the usual complications of sawdust-distillation by a combination of the distillation of the wood and the manufacture of producer gas from the charcoal. This was accomplished by using an up-draft gas producer with wood as fuel. The wood in the form of sawdust and fine chips forms a cone-shaped pile in the gas producer, the upper part of which is wood in the drying stage, the next layer wood in the stage of destructive distillation, and the lower layers charcoal in the process of manufacture into producer gas. The heat required for distilling and drying is furnished by the hot gas. Since charcoal is not a product of this process, the difficulties with charcoal dust and with cooling the finely-divided charcoal are not encountered. This process has operated successfully from the mechanical standpoint in a small commercial unit producer, but unfortunately the wood used in these trials was of unknown mixed species, and therefore no comparative figures on the yields of methanol and acid were obtained. There seems to be no reason, however, why this method should not give the maximum yields of both acid and methanol, since the process is a continuous one and the temperature can readily be controlled. In localities where there is a demand for the producer gas obtained, this process should be very promising, but under present conditions the presence of large quantities of hardwood waste in localities where there is also a demand for power is uncommon.

THE STAFFORD PROCESS

This process was developed with the idea of utilizing fully the exothermic reaction of wood-distillation. The process and apparatus is of the simplest, consisting merely of a large, well-insulated chamber into which the dry, warm wood is introduced continuously. The heat of decomposition of the wood is sufficient to bring an equal quantity of dry, warm wood to the distillation point; and the process is, therefore, continuous without the addition of heat from the outside. A thick layer of charcoal is kept in the bottom of the retort and partly cooled charcoal can be withdrawn continuously or at intervals. This process has worked very successfully at small-scale trials, and it is reported that it is now being tried out in a commercial-sized unit. No figures have been given on the yields obtainable by this process, but there seems to be no reason why the maximum yields of methanol and acid should not be obtained.

THE SEAMAN PROCESS

The Seaman process was developed and demonstrated in a commercial-sized unit several years ago. The apparatus consisted of a rotating inclined retort about

30 ft. long by 3 ft. in diameter. The hot, dry sawdust was charged at the upper end and the charcoal was removed continuously from the lower end. The ingenious devices¹⁴ for introducing the sawdust without introducing air and for removing the charcoal without allowing the escape of gas were found to work very satisfactorily on this demonstration retort. The yield of acetic acid obtained in this apparatus was unusually high, but for some unknown reason the methanol yields were somewhat low. A commercial plant to use this process was ready for operation early in 1918, but many difficulties were encountered, especially the plugging of the condensers by charcoal dust which was carried over from the retorts. It is reported that these difficulties have now been overcome and that several of the retorts are now operating continuously and commercially.

It should be noted here that the problem of sawdust distillation is perhaps not so important as is generally believed. This is for the reason that hardwood sawdust cannot be obtained in quantities sufficient for running a commercial wood-distillation plant without transportation, and sawdust is too cheap and bulky a material to permit profitable transportation for any considerable distance. Therefore, the only sawdust-distillation process which will be of importance commercially is the one which secures such economical operation or such high yields that it can afford to purchase and grind up large pieces of wood to use along with the sawdust.

Removal of Glue Stains*

Casein and vegetable glues containing caustic soda produce stains on certain kinds of wood, notably the oaks, maple, cherry, elm, ash, birch and beech. Some glues stain the wood more than others, and those that contain the most alkali are likely to be most injurious. The staining is due to the action of the alkali in the glue on the tannins and other constituents of the wood, whereby a substance related to ink is formed. No means have yet been found for preventing this chemical action. Precautions can be taken, however, which will keep the discoloration from the finished surfaces.

The most trouble with glue stain in woodworking is caused by the penetration of the glue solution through thin face veneers. This seepage is very likely to occur if the veneer is less than $\frac{1}{16}$ in. thick and somewhat porous. The consistency of a glue in part determines whether it will be squeezed through the wood or not. It is quite obvious that under similar conditions a thin glue will penetrate farther than a thick glue. For this reason the quantity of water that is added to a glue might be diminished and "fillers" added when staining is feared.

If a panel is dried promptly, the caustic soda solution will have difficulty in coming to the surface. Rapid drying can be brought about by removing the panels from the press as soon as it is safe to do so, and placing them on stickers.

Casein and vegetable glue stains can be almost entirely removed by sponging the stained surface with an oxalic acid solution prepared by dissolving an ounce of oxalic acid crystals in about 12 ounces of water. Still better results may sometimes be obtained by moistening the wood first with a sodium sulphite solution made up in the same concentration as the oxalic acid. In this way very stubborn stains can be almost obliterated.

¹⁴U. S. Pat. 1,236,885.

*From *Technical Notes*, Forest Products Laboratory.

Chemical Control of the Process for De-inking Paper

By C. M. JOYCE

DURING the past fifteen or twenty years, numerous methods for de-inking waste paper have been proposed. Many of these have been tried on a large scale involving great expenditure for equipment and materials. The net result of all this effort, however, may be expressed by saying that most mills are just where they started. The paper maker of today has little faith in new de-inking processes; he is not inclined to spend any time or money trying them. For this reason he is called narrow and unprogressive.

A careful study of the causes of these failures would justify the paper maker in his attitude. Many of those who have proposed de-inking methods have never seen a mill at all, do not have the working knowledge to take account of the interrelations of the market for raw materials and finished paper, cost of chemicals, and special mill conditions. There is no need for extra refinement in de-inking newsprint when the only use for the finished pulp is box board and cardboard filler. There is no use in recommending chemicals worth more than the pulp.

A valuable process for recovering newsprint, discovered by Baskerville and Stevenson,¹ has not received the attention it deserves because it has not provided for the mill difficulties in handling slack sized paper. Mill superintendents immediately raised the question whether newsprint can be used successfully in quantity on account of its rapid absorption of water and tendency to form bunches difficult to disintegrate. A mass of newsprint introduced rapidly into a de-inking bath accumulates near the top, forming an unwieldy wet mass which will often break a paddle before it disintegrates. Without waiting to see how this trouble may be overcome, mill men, with recollections of previous failures, do not care to consider the process. So the old soda boil, followed by washing of the resultant steaming, bad smelling, yellow mass, persists while chemists look on with disgust at the primitive mill methods.

After such a pessimistic beginning, the reader of this paper will not expect a solution of this important problem and the writer will not be sanguine enough even to attempt to propose one. However, a few general principles have been developed out of years of wide effort with small results, and these will be set forth in the hope that they will suggest improvements which some mill men may find adapted to their conditions.

APPARATUS AND TREATMENT

In preparing book stock and newsprint, it is highly desirable to loosen the ink before subjecting the stock to any pulping process which imbeds the ink in the fiber in such a way that its removal is impossible. It is also desirable to use the mildest possible chemical treatment, best accomplished by adjusting the amount of soda ash to a minimum quantity. A temperature somewhat less than boiling is an undoubted advantage as it makes it possible to turn out a pulp less tendered and less yellow.

Had the outside chemist not already discredited himself by proposing chemicals whose price is out of

reason, and apparatus too expensive or unwieldy to handle, he might make a real improvement in the average mill by painstaking adjustment of the factors mentioned.

For the de-inking bath, a boiler can be fitted up for external circulation by connecting it at the bottom to the intake of a rotary pump which discharges tangentially near the top of the boiler. By means of a Y-valve connection, the contents of the boiler can be pumped to the washer when finished. The paper may also be treated with de-inking chemicals in an ordinary beater used with the roll lifted clear of the bed plate (so that the ink will not be ground into the fiber), with a steam supply to raise the temperature of the contents nearly to boiling. If the beater has been used only for cold water previously, the wooden filler between the roll knives should be treated to withstand hot water. For removing the loosened ink a Lancaster washer has been used successfully by many mills.

CHEMICAL CONTROL REQUIRED

The form of apparatus used is less important than the careful chemical control of the process. To obtain the desired quality of product, maximum production and minimum cost of chemicals the following factors must be considered: (1) Ratio of water to weight of paper treated, (2) amount and kind of chemicals used, (3) rate of circulation of alkaline bath, (4) temperature, and (5) time. Increasing proportions of water make the pulp flow more freely so that the ink is more readily loosened by the chemical treatment. The amount is of course limited inasmuch as too large a proportion of water curtails the production. The more freely the pulp flows and the greater the agitation, the smaller the amount of chemicals required, because they will more readily come in contact with the pulp. It is important to have perfect circulation in order to avoid the possibility of a bunch of paper lodging somewhere until the chemical treatment is ended and then becoming free and distributing ink specks throughout the whole mass. Not infrequently excess chemicals are added to overcome defects in reality caused by poor circulation, a practice which adds to the expense and tenders and yellows the fiber. The adjustment of the temperature is also important as too little heat impairs the chemical action and too much heat degrades the fiber. The time of treatment should be determined by taking samples every 15 minutes and washing them on a screen and continuing the treatment until no more ink specks appear.

The success of the chemical control depends on the intelligent co-operation of the chemist with the mill superintendent, a condition which now seems to exist only in the largest mills.

Leominster, Mass.

Paper Manufacture in Japan

The *Japanese-American Commercial Weekly* reports that investigation made by the Association of Japanese Paper Mill Owners shows that the volume of paper manufactured by them during 1920 totaled 565,926,000 lb., an increase of 46,785,000 lb. as against the year 1919.

During 1920, 23,120,000 yen worth of paper was exported and 17,400,000 yen worth was imported, the figures representing a decrease of 2,270,000 yen and 970,000 yen, respectively, as against the preceding year.

The Hardness of Solid Solutions*

In Solid Solutions, Atoms of a Metal Replace Those of the Solute; Solubility Varies Inversely and Gain in Hardness Varies Directly as the Amount of Distortion in the Space Lattice, and Resultant Increase in Internal Energy

BY WALTER ROSENHAIN

National Physical Laboratory, Teddington, England

IT IS a well-known fact of metallurgy that the addition of one metal to another produces an increase of strength and hardness. In some alloys, this change of properties is accompanied by the formation of a new micro-constituent or phase, which is itself harder, and also, as a rule, more brittle than either of the constituent metals. In a very large and important group of alloys, however, the addition of the second metal, up to certain limits of concentration, does not lead to the formation of a second phase or constituent.

STRUCTURE OF SOLID SOLUTIONS

Alloys of this type, when they have attained an equilibrium condition, consist of an aggregate of polyhedral crystals, homogeneous in composition so far as their micro-chemical behavior indicates, and in most respects entirely similar to the constituent crystals of the pure metal, which forms the basis of the alloy. A typical example of this kind is furnished by the alloys of copper with zinc, containing up to about 30 per cent of zinc. Alloys of this type are generally described as "solid solutions," on the ground that the state of intimate mixture which exists in the liquid (molten) solution of the two metals in one another is preserved in these alloys after solidification. In Continental language, such crystals are more frequently termed "mixed crystals" ("Mischkrystalle"), but the present author prefers to avoid this term on account of a possibly misleading interpretation.

A further fact in connection with metallic solid solutions is also well known, but appears to require explanation. A solid solution alloy is always harder and stronger than the pure metal of which it mainly consists, and frequently this difference in physical properties is very marked. Thus, annealed pure copper has a Brinell hardness number of 36, and a tensile strength of about 13 tons per sq.in. An alloy of copper containing 30 per cent of zinc in solid solution, on the other hand, in the corresponding annealed condition, has a Brinell hardness number of 57, and a tensile strength of 20 tons per sq.in. It is the purpose of the present paper to suggest an explanation for this hardening and stiffening effect of the added metal in solid-solution alloys, and to show that this explanation leads to an inference which is in striking accord with well-known facts.

The explanation of the properties of solid-solution alloys which is put forward in the present paper is based upon a conception of the manner in which two metals may crystallize together in the form of solid-solution crystals. As a result of the X-ray analysis of crystal structure, mainly carried out by Sir William H.

Bragg and W. L. Bragg¹ and by A. W. Hull² it is now known that, in a metallic crystal, the atoms of the metal are arranged in certain definite ways on a space-lattice, and that this arrangement may differ in detail from one metal to another, not only in regard to the nature of the lattice (cubical or otherwise) and the occupied points, but also in regard to the normal inter-atomic distance or spacing of the lattice. On the view now put forward, the crystals of a solid solution of metal B in metal A are built up on the same space-lattice as crystals of pure A, the sole difference being that a certain number of individual atoms of A are replaced by atoms of B. It is obvious that the extent to which such an arrangement will be possible must depend upon the relation which exists between the atoms of the two metals. If both tend to take up a similar space-lattice arrangement, and if their normal inter-atomic distances do not differ very much, a single crystal may be built up, upon the normal space-lattice arrangement of A, using atoms of A and B indiscriminately, up to a considerable proportion of B. If the similarity of the two kinds of atom is sufficiently great, then such an indiscriminate construction might easily be conceived as being possible in all proportions between the two kinds of atom. In that case, we should expect to find that the two metals could form homogeneous solid solutions when alloyed in any proportion ranging from pure A to pure B. Such cases are, of course, well known among pairs of very similar metals, such as iron and nickel or silver and gold.

ATOMS OF LIKE SHAPE, FORCES AND NATURE FORM BEST SOLID SOLUTIONS

Where the similarity, in regard to crystalline habit and arrangement, of the two kinds of atom is less complete, it would be anticipated that, up to a certain concentration at either end of the series, the atoms would be built together, indiscriminately upon a single space-lattice, but that, beyond certain limits of concentration, the two kinds of atoms would become segregated into two kinds of different crystals, thus giving rise to a duplex structure of two distinct kinds of crystals, each consisting of saturated solid solution of one metal in the other. The degree of dissimilarity of the two kinds of atom would determine the exact concentration at which this separation occurs, and we would thus expect to find in metallic alloy systems all gradations, ranging from complete mutual "solid" solubility down to almost complete insolubility in the solid state; it is, of course, well known that such gradations are found among known alloys.

From the present point of view, however, interest

*Reprinted from *Proceedings of the Royal Society, Series A*, vol. 99, No. A698, p. 198.

¹W. H. and W. L. Bragg, "X-rays and Crystal Structure," p. 173.
²A. W. Hull, "A New Method of Chemical Analysis," *J. Amer. Chem. Soc.*, 1919.

centers on the determining factor which governs the limiting solid solubility of metal B in metal A. If the view of the structure of a solid-solution crystal indicated above is correct, it follows that the actual arrangement of the atoms on the space-lattice typical of metal A cannot exist entirely undisturbed when some of the atoms of A are replaced by atoms of B. The forces acting on any atom of A, for instance, when one of its neighbors in the lattice is an atom of B, cannot possibly be the same as those acting on an atom of A entirely surrounded by atoms of A; there must thus be some want of symmetry in the forces acting on an atom so placed, with a result which is perhaps best expressed by saying that such an atom will be pulled slightly out of its proper place, *i.e.*, that the space-lattice will be slightly distorted at such points. Now, it is evident that such distortion must affect the internal energy of the whole system, and this effect must increase with the increase in the amount of distortion which accompanies the presence of a larger number of atoms of B. A point will therefore be reached when the energy-content of the system as a whole will be less if the atoms of B are separated and arranged on a space-lattice of their own. Such an arrangement implies the existence of boundaries between two different kinds of crystal and the accompanying storage of energy in such boundaries, and it is the balance between the energy-content of the two geometrically possible types of arrangement which must determine the limiting concentration of the solid solution in each case.

POSITION OF DISSOLVED ATOMS IN EQUILIBRIUM

With a full knowledge of the forces at work between adjacent atoms it would be possible to calculate the limiting concentration of any solid solution from the character of the constituent atoms; in the present state of our knowledge, all that can be said is that the greater the extent to which the space-lattice is distorted in the neighborhood of "dissolved" atoms (atoms of "B") the lower will be the limit of solid solubility of B in A. During the process of formation of such a solid solution, a great deal must depend upon the uniformity with which the atoms of B are distributed through the space-lattice. If there is a concentration of the dissolved atoms in any region, then there must be a tendency for rearrangement to occur with a view to arriving at some symmetrical arrangement which shall correspond to the minimum energy-content. If such a distribution is really symmetrical, then an interesting result must follow, *viz.*, that in a solid solution which has been allowed to attain equilibrium conditions, the dissolved atoms will be distributed through the crystals in such a way as themselves to constitute some sort of space-lattice of their own. This is a conclusion which is capable of experimental verification by means of X-ray analysis; when the result is obtained, however, it will be important to realize that the existence of such a secondary space-lattice arrangement of the dissolved atoms (B) does not imply the existence of separate crystals of B. The further question of how far a solid solution which has attained such a state of symmetrical arrangement approaches to the character of a chemical compound need not be discussed here.

The most important conclusion which emerges from what has been said above is that the "solid solubility" of metal B in metal A will be, to a first approximation,

inversely proportional to the amount of distortion of the normal space-lattice of A caused by the substitution of an atom of B for an atom of A in that lattice. The importance of this consideration lies in the fact that this amount of distortion of the space-lattice of A by the presence of B also governs certain of the physical properties of the resulting alloy, particularly the hardness of the material and its resistance to mechanical deformation generally.

HARDNESS IS SLIP RESISTANCE

It is now well recognized that the ductility of metals, *i.e.*, their power of undergoing plastic deformation without rupture, resides in their essentially crystalline character. Plastic deformation takes place within the crystals of metals by a process of slip, occurring on gliding or cleavage planes,⁵ whereby the crystals accommodate themselves to the new shapes forced upon them by the deformation of the mass. It is precisely the power of the crystals to undergo such slip which governs the ductility of the metal, and their power of resisting slip which determines their power of resisting deformation. If this view is correct, then anything which tends to hinder the free occurrence of slip on the principal planes of a crystal will increase the hardness (or power of resisting deformation) and will lower the ductility of the material. The application of any appreciable amount of plastic deformation (or "cold work") is known to act in this manner, and does so, according to the views of Beilby⁶ by the partial destruction of the crystalline arrangement of the atoms within the crystals.

The view which it is desired to put forward here is that any even slight distortion of the space-lattice of the crystals of a metal by the presence of "dissolved" atoms of another metal, in the manner indicated in the earlier part of this paper, must serve as a hindrance to slip on the crystal planes. Strictly speaking, in fact, the crystal "planes" have ceased to exist in such a slightly-distorted crystal. The very facility for slip which renders metallic crystals soft and ductile depends upon the smooth regularity with which the atoms are arranged on their space-lattice, and if this smoothness is lessened by the slight distortion of the lattice, it is obvious that slip will be rendered more difficult, and this difficulty will increase, to a first approximation, proportionately to the amount of distortion existing in the space-lattice.

HARDNESS GREATEST WITH LIMITING SOLUBILITY

Combining this last inference with the one already drawn above in regard to the factor governing the limiting solid solubility of one metal in another, we arrive at the following conclusion: that since the amount of distortion which the introduction of a given "dissolved" atom produces in the space-lattice of the solvent metal governs both the limiting solubility of the dissolved metal and the degree of hardening produced in the solvent metal, we should expect to find that the hardening effect of one metal upon another in the form of a solid solution should, to a first approximation be inversely proportional to its solid solubility.

This very general conclusion, which—so far as the author is aware—has not been previously stated, ap-

⁵Ewing and Rosenhain, *Phil. Trans.*, A, vol. 249 (1899).

⁶Beilby, "The Hard and Soft State in Metals," *Phil. Mag.*, August, 1904; also *Proc. Roy. Soc.*, A, vol. 76, p. 462 (1905), and *Proc. Roy. Soc.*, A, vol. 79 (1907).

pears to be in good general agreement with experimental fact. There are, in the first place, a certain number of binary alloy systems which consist of unbroken series of solid solutions. In some of these, of which gold-silver and iron-nickel¹ are good examples, the shape of the liquidus curve suggests that the two kinds of atoms are very similar, since the alloys solidify in a manner closely approximating to that of a pure metal. In these cases there is very little hardening effect of one metal upon the other. The alloys of copper and nickel² also forms a series of unbroken solid solutions, but their freezing range is distinctly larger, so that the alloys depart further from the behavior of pure metals. Here, where there is thus some evidence of slightly greater dissimilarity between the atoms, there is a distinctly greater hardening effect. Finally, in the case of the alloys of copper with manganese we have an alloy system still forming what appears to be an unbroken series of solid solutions, but the shape of the freezing point curve suggests that the system is one in which the series of solid solutions has only just been maintained and that a very slightly greater divergence between the component atoms would have led to the occurrence of a short range of duplex alloys. Here a still greater degree of hardening is found than in the systems previously mentioned.

SATURATED SOLID SOLUTIONS HAVE APPROXIMATELY EQUIVALENT PHYSICAL PROPERTIES

Still more striking evidence in support of the generalization stated above is to be obtained from a consideration of alloy systems in which the range of solid solutions is definitely limited. Unfortunately, the ranges of solid solubility for alloys in true equilibrium have only been determined with sufficient accuracy in a comparatively few instances, while a detailed knowledge of the corresponding mechanical properties is also lacking in many cases. For the alloys of copper and for those of aluminum, however, adequate data are available. In regard to copper, the alloys with nickel and manganese have already been mentioned. In the well-known alloys of copper with zinc³ (brass, etc.), solid solutions can be obtained at the copper end of the series containing up to about 36 atomic per cent of zinc (equivalent to about 37 per cent of zinc by weight). The corresponding limit for aluminum in copper⁴ lies at about 14 atomic per cent of aluminum (corresponding to about 7 per cent by weight), while, for tin in copper, the limit lies near 6.7 atomic per cent (equivalent to 12 per cent by weight). In good correspondence with these figures are the facts concerning the hardening effects of these three metals on copper. It is difficult to give exact quantitative data, since tests on the alloys in a strictly comparable condition are not readily available, but there can be no doubt that the hardening effects of the three metals are distinctly in the inverse order of their limiting solid solubilities expressed in atomic percentages, as given above. Thus

the well-known brass, containing 70 per cent (by weight) of copper and 30 per cent of zinc, is still very ductile. The ductility of the alloys of copper with aluminum decreases rapidly after an aluminum-content of 7 per cent has been passed, while, in the case of the copper-tin alloys, an addition of 4 per cent of tin (by weight) almost exhausts the ductility of the material. It appears probable, again to a first approximation, that the saturated solid solutions of copper containing any of the soluble metals will have approximately similar mechanical properties, independently of which metal has been used to bring about saturation. Since, however, the solubilities in some cases are high, the physical properties of the dissolved metal itself must affect such a conclusion, which is none the less broadly in conformity with the facts.

Similar evidence is to be obtained from a consideration of the alloys of aluminum with zinc and copper.⁵ In the aluminum-zinc series, solid solutions containing above 15 atomic per cent of zinc (equivalent to a little under 30 per cent of zinc by weight) can be obtained, while, in the aluminum-copper series, the limiting solid solubility lies in the neighborhood of 1.5 atomic per cent of copper (about 4 per cent by weight). In conformity with this difference in solid solubility, we find that the hardening effect of copper on aluminum is very much greater than that of zinc. Actually, it is much more difficult, on account of slower diffusion, to obtain really saturated solid solutions of copper in aluminum than of zinc, but, when saturation with copper has been obtained, it is found that the physical properties of the resulting alloy (containing about 4 per cent of copper by weight) are not very different from those of a solid solution of zinc in aluminum containing about 30 per cent (by weight) of zinc.

Reference may further be made to the alloys of iron. The solid solubility of carbon in γ -iron is of the order of 2 per cent by weight. In accordance with this figure, we find the enormous influence of carbon on the physical properties of iron, as compared with the effects of the highly soluble elements, such as nickel or silicon.

World's Production of Bauxite and Aluminum

The Imperial Mineral Resources Bureau, which is conducting inquiries in many directions, has issued a report on aluminum and bauxite of considerable value.

Perhaps the most valuable portion of the report consists of two tables presented below, giving (in long tons) the world's production of bauxite and aluminum, the figures relating to the latter being estimates:

Countries	1913	1914	1915	1916	1917	1918	1919
	Tons	Tons	Tons	Tons	Tons	Tons	Tons
United Kingdom	6,055	8,286	11,723	10,329	14,724	9,589	9,221
British Guiana						2,037	4,199
India	1,184	514	876	750	1,363	1,192	1,682
France	304,323	.....	55,614	104,493	118,973	.....	160,820
Hungary			58,118				
Italy	6,840	3,843	5,805	8,744	7,664	7,675	2,924
Spain						453	1,751
United States	210,241	219,318	297,041	425,100	568,690	605,721	376,566
Total	528,643	231,961	429,177	549,416	713,451	628,829	552,964

	Aluminum						
United Kingdom	7,500	7,400	7,000	7,600	7,000	8,200	8,000
Canada	6,000	6,500	6,000	7,500	8,000	8,000	8,000
Austria	2,000	2,000					
France	13,283	9,803	5,920	9,447	18,886	11,826	12,000
Germany	1,000	1,000	1,000	8,000	20,000	25,000	12,000
Italy	860	922	889	1,108	1,712	1,687	2,000
Norway	7,000	4,000	8,000	12,000	15,000	15,000	10,000
Switzerland	10,000	15,000	10,000	12,500	15,000	15,000	15,000
United States	29,000	41,500	44,500	62,500	80,000	85,000	80,000
Total	71,643	88,125	83,309	120,665	157,598	169,713	147,000
Official figures	1919	figures estimated.					

Editor's Note: The following are results by Hull, except Westgren's figures for the crystallography of gamma iron:

Metal	Crystal Form	Side of Elementary Crystal	Center to Center Nearest Atoms
Gold	Face-centered cubic	4.08	2.88
Silver	Face-centered cubic	4.06	2.87
Gamma Iron	Face-centered cubic	3.58	2.53
Nickel	Face-centered cubic	3.54	2.50
Copper	Face-centered cubic	3.60	2.54
Zinc	Close-packed hexagonal		2.84
Aluminum	Face-centered cubic	4.05	2.86
Gray Tin	Diamond	6.46	2.80

Evaporation by Vapor Compression

BY BURTON DUNGLINSON

EVAPORATION cannot proceed, broadly speaking, unless there is a temperature difference between the heating medium and the liquid being heated. To obtain this temperature difference it is universal practice to employ vacuum systems, which, by reducing the pressure above the liquid, allow ebullition to take place at a lower temperature.

The temperature differences obtained with a triple-effect vacuum evaporator operating at usual vacuum and using exhaust steam at 3 lb. pressure, are shown in the following table:

APPROXIMATE TEMPERATURE DIFFERENCES OBTAINED WITH TRIPLE-EFFECT VACUUM EVAPORATOR

	First Effect	Second Effect	Third Effect
Vacuum (in inches of mercury).....	5	15	28
Pressure of steam (lb. absolute).....	17.7	12	7
Corresponding temperatures, deg. F.....	222	202	177
Boiling point at given vacuum, deg. F.....	180	155	130
Temperature differences, deg. F.....	42	47	47

This demonstrates a maximum temperature difference of 47 deg. F. and an average of about 45 deg. F.

Another way of obtaining this temperature difference is by compressing the evaporated steam and vapors and returning these, either to the heating system of the evaporator or to a second evaporator arranged in series with the first. To obtain a difference of 45 deg. for a solution, which does not increase appreciably in boiling point as concentration proceeds, it will be necessary to compress the evaporated steam to 20 lb. more than its original pressure.

This does not apply to most solutions met with in evaporator practice, since they usually have a considerable elevation of the boiling point before final concentration is reached. This means that, in order to obtain efficient evaporation per sq.ft. of heating surface, very high pressures must be employed, and in fact the compression systems usually require the use of double or triple stage rotary compressors for such industrial operations.

Where it is desired to produce only distilled water or at the most to concentrate a solution to not more than 5 deg. Bé. a simple expedient, which was the forerunner of the vapor-compression systems, has been found readily adaptable to single-effect evaporators.

This apparatus, known as the "Simplex" film evaporator, was developed in London mainly for evaporating sea water. It involves the adaptation of a steam injector to the vapor outlet of the evaporator, the mixed vapor being fed back to the calandria. The efficiency of such steam injectors is extremely low, and only a portion of the evaporated steam can be returned.

Since the whole principle of vapor compression systems depends on low temperature differences, with consequent low compressions, it naturally follows that multiple effects on some such system would have to be used in order to create the desired temperature differences and hence evaporation. Sea water contains about 3 per cent soluble chlorides and when saturated contains about 30 per cent of soluble chlorides. The rise in boiling point in this solution between the concentrations stipulated is about 9 deg. F.

THE SÖDERLUND-BOBERG EVAPORATOR

The Söderlund-Boberg evaporator consists of three elements connected with a multi-stage turbo-compressor. The steam from the evaporating spaces of all of the elements is compressed to a sufficient extent in the

first stage of the compressor for use in the heater of the first element. The excess of steam over that required in the first element is then compressed in the second stage of the compressor to render it fit for the second heater, and the residue from the second heater is then finally compressed in the last stage of the compressor to render it available for the last heater. Each element has its own circulating pump and the hot condensate from the three elements is combined and supplied to a common feed heater.

CONSTRUCTION AND OPERATING DETAILS

A sectional elevation of one element of the evaporator is shown in Fig. 1. The evaporator is comprised of a tall shell *A*, the greater portion of which is taken up by the calandria *B*. To the upper end of each tube *C* is fitted a ferrule (see insert Fig. 1) with a distributing nozzle *E*. The liquid, which is raised by a pump *F* from the lower portion *G* of the shell *A*, is fed into the tray *H*

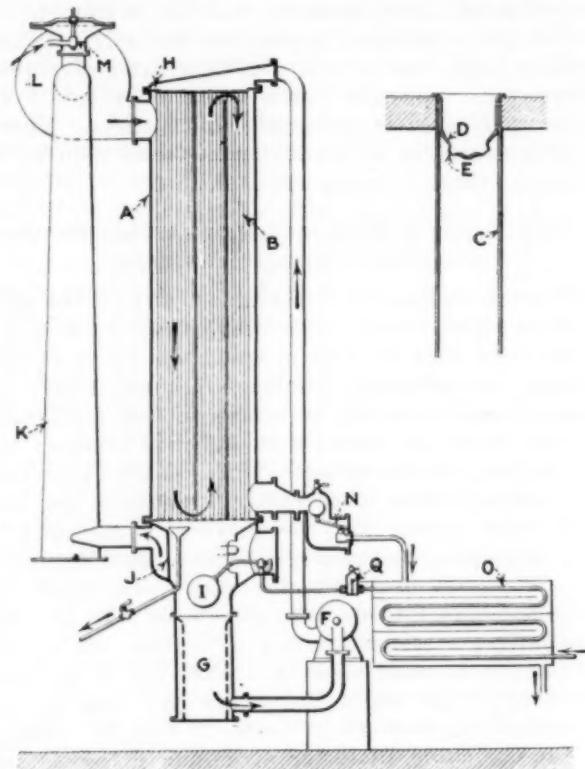


FIG. 1. SECTIONAL ELEVATION OF SINGLE STAGE SÖDERLUND-BOBERG EVAPORATOR

formed at the top of the calandria, and after passing through the nozzle in the ferrules is spread as a thin and rapidly moving film over the inner surface of the tubes *C*.

The liquid collects again in the bottom of the shell, to which fresh liquid is automatically admitted by the constant level feed *I*. Thence it is returned by the pump *F* to the distributing tray *H*. The steam which is given off by the films inside the tubes and that which is separated from the spray by the baffles *J* and by the tangential disposition of the steam entry passes to the compressor *L*. The required quantity of make-up steam is added to it on its way by the pressure-controlled automatic steam inlet *M*. The compressed steam enters the space around the tubes *C* and condensing on them is drained off as hot water through the steam trap *N* connected to a counter-current regenerator or pre-heater *O*.

The small quantity of non-condensable gases from the feed liquid escapes through the blow-off Q or is cleared out of the steam space either by the periodically blowing-off of a little steam or by the continuous emission of a small quantity of steam from this space.

The compressor is driven at a constant speed by a spur gear from a shaft which in turn is belt-driven directly by a gas or oil engine. The exhaust from the engine passes to a small boiler for generating the make-up steam.

CHARACTERISTICS OF FILM EVAPORATION

An important fact in connection with the claims of this system of evaporation is the insistence that a film of the liquid under treatment is circulated down the tubes. Although this is in direct opposition to the direction of flow to be met with in a standard film evaporator, it nevertheless demonstrates the advantages to be gained from the adoption of the film as a means to increased efficiency. An important point which is conceded to the film evaporator is the absence of scaling and incrustation. The writer has found in experiences with various liquids in film evaporators that the high velocities, rapid circulation and continuous motion in an upward direction tend to scour and burnish the tubes rather than to form scale. In this connection the patentees of the Söderlund-Boberg evaporator say: "Film evaporation is, however, notoriously beneficial as regards reduction of scale formation, and experience in climbing film evaporation has shown, what numerous trials with the Söderlund-Boberg evaporator have since confirmed, that the rapid circulation and uniform wetting to which the surface is subjected play an important part in reducing this tendency to within small limits."

MULTIPLE STAGE INSTALLATIONS

The evaporator when used in multiple stage may be considered as a series of units such as have been described. An installation designed for concentrating sea water is shown in Fig. 2. The condensates from the calandria of these units are combined and pass to a single heat regenerator. The concentrate from the bottom of the shell of the one element passes to the next element, and the vapor from all of the elements passes to the common compressor, where its tempera-

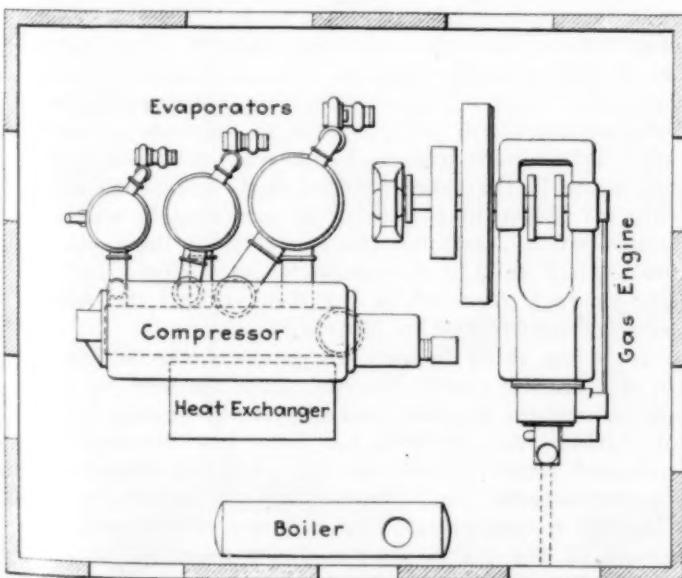


FIG. 2. MULTIPLE STAGE INSTALLATION FOR SEA WATER EVAPORATION PLANT

ture is raised enough for use in the first calandria. The uncondensed residue of steam then enters into a second compressor or into the second stage of the same compressor and is heated by compression for use in the next calandria.

It is claimed that with this system, producing salt from sea water, there is an evaporative ratio equal to 12 lb. of water per lb. of steam. Such results are truly remarkable and we may look forward to the time when this energy system really proves its value.

Sulphur in Malleable Cast Iron

BY LESTER C. CROME*

IT IS generally known that the evolution method for the determination of sulphur in such materials as white cast irons is not at all reliable. It is also true that the oxidation methods require too much time for advantageous use in a control laboratory. Being confronted with the problem of obtaining a rapid and accurate analysis of white cast irons, a thorough investigation of the problem was made, revealing some very interesting facts and also disproving some popular ideas concerning the determination of sulphur in white irons by the evolution method.

VARIATION BETWEEN EVOLUTION AND OXIDATION METHODS

Complete chemical analyses with duplicate determinations of carbon, evolution sulphur and oxidation sulphur were obtained on forty samples of white iron,

TABLE I. CHEMICAL ANALYSES OF THE WHITE CAST IRONS

No.	C*	Si	P	Mn	Sulphur* Evolution	Sulphur* Oxidation
1	2.75	0.94	0.173	0.29	0.050	0.050
2	2.63	1.05	0.167	0.31	0.050	0.051
3	2.95	0.58	0.068	0.03	0.066	0.070
4	2.77	1.08	0.171	0.31	0.041	0.051
5	2.72	1.03	0.168	0.30	0.043	0.047
6	2.78	0.73	0.078	0.05	0.058	0.101
7	2.47	0.93	0.169	0.28	0.043	0.084
8	2.64	0.94	0.172	0.27	0.040	0.083
9	2.98	0.71	0.080	0.06	0.058	0.102
10	2.53	0.75	0.168	0.20	0.037	0.037
11	2.74	0.93	0.167	0.28	0.042	0.045
12	2.87	0.89	0.076	0.05	0.060	0.062
13	2.55	1.07	0.165	0.29	0.040	0.071
14	2.57	0.85	0.172	0.23	0.041	0.076
15	3.01	0.78	0.075	0.06	0.056	0.088
16	2.59	0.88	0.170	0.28	0.052	0.081
17	2.70	0.94	0.161	0.30	0.043	0.070
18	2.77	0.82	0.173	0.30	0.041	0.074
19	2.81	0.87	0.167	0.25	0.053	0.073
20	2.76	0.94	0.168	0.29	0.047	0.077
21	2.73	0.92	0.171	0.29	0.047	0.083
22	2.68	0.81	0.155	0.25	0.050	0.052
23	2.77	0.94	0.169	0.33	0.049	0.058
24	2.51	0.87	0.170	0.29	0.048	0.055
25	2.71	0.94	0.169	0.28	0.051	0.053
26	1.34	1.52	0.183	0.15	0.096	0.106
27	2.12	1.32	0.181	0.34	0.066	0.119
28	2.55	0.75	0.171	0.23	0.046	0.097
29	2.61	0.93	0.159	0.28	0.050	0.103
30	2.50	0.82	0.176	0.28	0.051	0.110
31	2.51	1.08	0.166	0.23	0.047	0.099
32	2.28	0.78	0.178	0.26	0.080	0.130
33	2.44	1.02	0.172	0.18	0.049	0.100
34	2.44	0.97	0.172	0.18	0.047	0.094
35	2.46	0.96	0.171	0.18	0.047	0.095
36	2.40	0.96	0.171	0.17	0.047	0.095
37	2.92	1.82	0.138	0.79	0.044	0.086
38	2.43	1.01	0.171	0.18	0.045	0.098
39	2.62	1.06	0.169	0.28	0.056	0.103
40	2.44	1.00	0.194	0.25	0.046	0.047

* The carbon and sulphur values were all checked by duplicate determinations.

with the idea that they might reveal some relation existing between the evolution and oxidation values and some third quantity such as the percentage of combined carbon or the carbon:silicon ratio. The results of this investigation listed in Table I showed no such relation—in fact, proved the contrary.

These results classified the samples into three groups as follows:

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(1) In about 25 per cent of the samples (Nos. 1, 2, 3, 5, 10, 11, 12, 22, 25, 40) the evolution and oxidation values checked.

(2) In another group (Nos. 7, 8, 14, 28, 29, 30, 31, 33, 34, 35, 36, 37, 38) the evolution method gave only about one-half or less of the total sulphur.

(3) The remaining samples gave varying values falling in between these two.

Samples with nearly identical complete analyses could be found in each of the three groups.

MISSING SULPHUR EVOLVED BUT NOT CAUGHT

Samples giving only a small part of their sulphur by the evolution method were studied more thoroughly to determine what became of the missing sulphur. Accordingly several of them were picked and 10-g. samples treated with hydrochloric acid exactly as in the ordinary evolution method. After the samples had dissolved, their solutions were filtered. The filtrates were oxidized with bromine, evaporated with nitric acid after the addition of sodium carbonate and examined for sulphur according to the regular oxidation procedure. The results of this experiment showed that the solutions contained no sulphur whatever. The residues were carefully dried at 100 deg. C. and tested for sulphur by using both the nitric acid solution method, that of the U. S. Bureau of Standards, and by fusing with a potassium nitrate and sodium carbonate mixture. These results showed that only traces of sulphur remained in the residues.

From the results of these experiments, listed in Table II, it was evident that the sulphur not obtained by the

TABLE II. EXAMINATION FOR MISSING SULPHUR

No.	Sulphur by		Sulphur in	
	Evolution	Oxidation	Residue	Filtrate
35	0.047	0.096	0.006	Nil
7	0.043	0.084	0.007	Nil
8	0.040	0.083	0.007	Nil

evolution method must be evolved as some sort of a gaseous compound which is not absorbed by the ordinary media.

SULPHUR LOST ON ANNEALING

There is a popular idea that by annealing a cast iron it will give its total sulphur by the evolution method, even though it did not do so before. Accordingly two test-bars of the class where only half of the sulphur was evolved were placed in an electric muffle at 1,890 deg. F. and allowed to cool very slowly with the furnace. Then the sulphur was determined on these samples by both the evolution and oxidation methods. The results of both methods checked very closely, but instead of agreeing with the original oxidation value, they checked that of the evolution value before annealing. An amount of sulphur equal to the difference between the two had been lost.

This proved to be very interesting.

Then five typical samples were selected from each group, and bars from these heats that had been through the annealing process in the regular annealing ovens (carbon completely graphitized) were obtained and their sulphur was determined by both the evolution and oxidation methods. These results, in Table III, substantiated those of the preliminary experiment, showing that the sulphur not obtained by the evolution method in the white iron was lost in the annealing process. In

all cases the sulphur values of both methods checked on the annealed samples, but in some cases they were slightly higher than the original evolution value, due to the small amount of sulphur which is usually taken up in the annealing oven.

These results show that in cases where the total sulphur in the white iron is not obtained by the evolution method it must be present in two distinct forms. That which is obtained is doubtless in the form of manganese and ferrous sulphides, and the remainder must be in some other form, but just what it might be the results obtained thus far do not show.

TABLE III. SULPHUR VALUES ON REGULAR ANNEALED SAMPLES

No.	Sulphur Before Annealing		Sulphur After Annealing	
	Evolution	Oxidation	Evolution	Oxidation
1	0.050	0.050	0.056	0.052
2	0.050	0.051	0.060	0.056
10	0.037	0.037	0.052	0.056
12	0.060	0.062	0.066	0.069
22	0.050	0.052	0.060	0.065
7	0.043	0.084	0.055	0.051
8	0.040	0.083	0.052	0.048
29	0.050	0.103	0.061	0.058
30	0.051	0.110	0.058	0.054
31	0.047	0.099	0.061	0.059
14	0.041	0.076	0.052	0.049
16	0.052	0.081	0.064	0.062
17	0.043	0.070	0.054	0.053
19	0.053	0.073	0.063	0.060
20	0.047	0.077	0.064	0.060

There is one point practically certain, however: no matter in what form this sulphur does exist, it does not have the same deleterious effects on the iron as the ordinary sulphur as sulphides. This, however, is only as might be expected from the fact that this amount of sulphur is subsequently lost in the annealing process.

In view of this fact, it is possible to determine the sulphur in white cast irons by the evolution process, for even though it does not give the total sulphur in all cases, it always gives that which is injurious, and that is all that is desired to know in the control laboratory routine.

An Extensometer Calibrating Device

BY R. L. TEMPLIN*

MOST of the extensometers made in this country and used by the various industrial and technical school materials laboratories are purchased and accepted from the maker as being correct. The instrument will generally measure correctly when received, although this is not always the case, but even the best extensometers will not continue to measure correctly after considerable usage. In general, an extensometer indicating to the nearest 0.0001 in. is sufficiently accurate for the ordinary testing of materials in which it is desired to determine the proportional limit, elastic limit, yield point and modulus of elasticity. This is the accuracy required by the standards of the American Society for Testing Materials.

It is one thing to have an extensometer indicating to the nearest 0.0001 in., and quite another to have the instrument measure correctly to the nearest 0.0001 in. within, say ± 0.00002 in. Very few industrial or technical school laboratories are equipped to calibrate an extensometer, or if so equipped the calibration devices are so cumbersome that they are seldom used. By means of the rather simple device described in this article, it is possible to check the various types of com-

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mercial extensometers with a degree of accuracy sufficient for ordinary testing.

Since most commercial-type extensometers have some system of multiplying levers in order to magnify the

0.001 in. we will find that the error in the calibration device micrometer becomes the small part of the indicated error of the extensometer. Attacking the problem of calibration from this angle makes it unnecessary to have the calibration device read correctly to 0.00001 in. It has been found sufficient for practical use to have the calibration device indicate only to the nearest 0.0001 in.

DESCRIPTION OF INSTRUMENT

The calibrating device consists essentially of a steel tube in the upper end of which is fastened a standard micrometer head, indicating to the nearest 0.0001 in. and in the other end of which a rod slides so as to form a telescoping bar (see Fig. 1). The lower end of this rod is fastened into a suitable stand or base. It is hardly necessary to state that the bar must have an accurate fit in the tube. Also the small adjustable key which keeps the tube from rotating on the bar must be well fitted.

In order to provide a suitable bearing for the end of the micrometer screw, a steel ball is placed in the center of the bar. While this ball does not rotate during the operation of the instrument, it nevertheless affords an inexpensive and quite suitable bearing.

The weights attached to the cross-arm at the top of the tube are provided in order to make the action of the instrument positive at all times. They should weigh from 1 to 2 lb. each. The weights are attached rigidly to the arm at such a distance from the tube as not to interfere with the operation of any extensometer likely to be calibrated. The micrometer head is held in place by a clamp which is made as part of the weight arm.

The shoulder near the middle of the bar acts as a stop for the tube when the micrometer head is removed or the micrometer screw removed for adjustment. The bar and tube should have an outside diameter of $\frac{1}{2}$ in. in order to accommodate the different extensometers on the market, which are intended for use only on the standard 0.505 in. diameter test specimen. It is advisable to have punch marks or small drilled holes (No. 56 drill) on opposite sides of the bar and tube, 1 in. and 4 in. above and below the shoulder of the bar.

The accuracy of the instrument is, of course, based

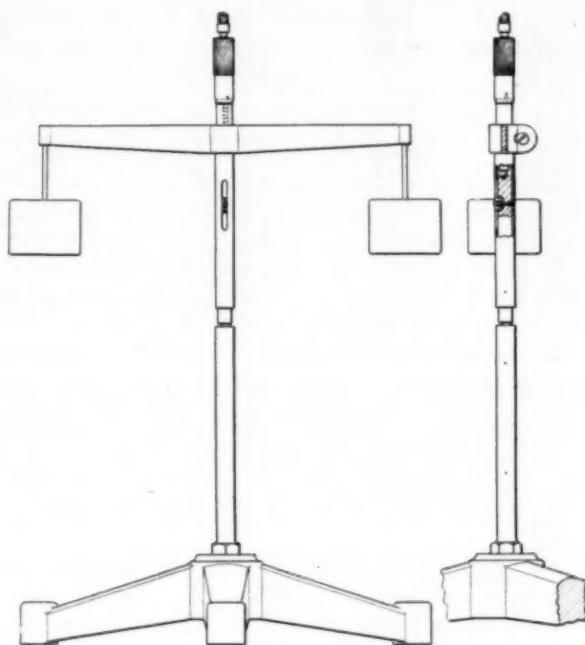
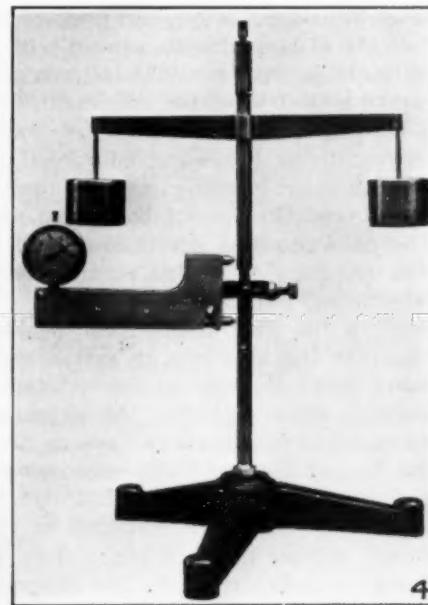
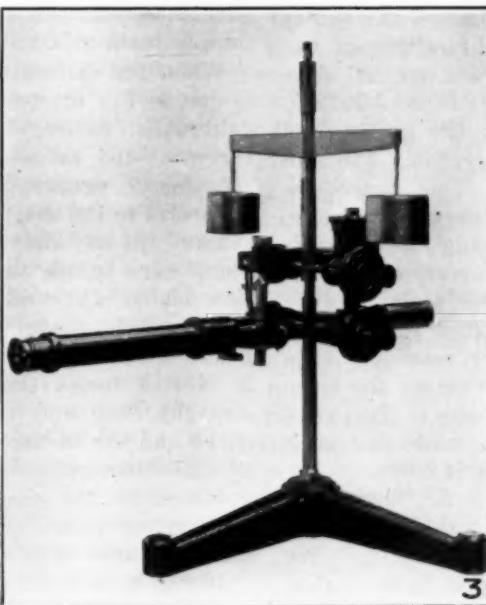


FIG. 1. SIDE VIEW AND CROSS-SECTION OF CALIBRATING DEVICE

strains whose magnitudes are to be measured, advantage is taken of this magnification in their calibration. Any error caused by an error in the length of one or all of the levers in an extensometer is multiplied considerably if the extensometer is made to function throughout its whole range of measurement. For example, the observed differences in the readings of the extensometer and calibration device throughout the range of deformation of 0 in. to 0.001 in. may be so small as to be directly comparable to the error of the calibration device micrometer, but if we extend the range of the calibration curve to ten or twenty times



FIGS. 2 TO 4. VARIOUS EXTENSOMETERS ARRANGED FOR CALIBRATION

Fig. 2. 2-in. Riehlé extensometer. Fig. 3. 2-in. Ewing extensometer. Fig. 4. 2-in. Berry strain-gage.

upon the accuracy of the micrometer head, and for this reason the micrometer head which has been selected for the instrument should be calibrated. The U. S. Bureau of Standards is equipped for doing this at a nominal charge.

Some extensometers, because of their inherent design, will indicate strains accurately in but one direction. This is a common fault with instruments having indicating dials due to back-lash in the gear trains of the dials. The calibrating device will operate positively in either direction, so it is very well suited for checking up extensometers of this type.

METHOD OF PROCEDURE

In operation, the extensometer is attached to the instrument as shown in Figs. 2, 3 and 4. Care should be used not to clamp the extensometer too tightly on the tube, else the tube will be deformed enough to keep it from sliding freely on the bar. Since the extensometer readings are to be referred to the readings of the increments of the calibrating device, the extensometer is usually set at some even figure or preferably zero. If the extensometer has a zero adjustment, it

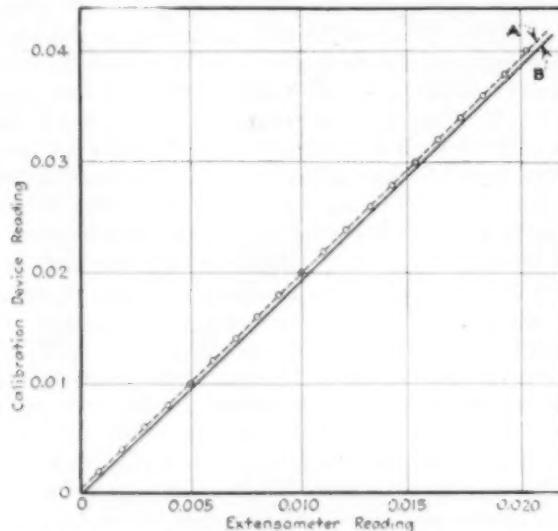


FIG. 5. CALIBRATION CURVE OF A 2-IN. RIEHLE EXTENSOMETER

saves considerable computation work to set the extensometer at zero simultaneously with the setting of the calibrating device. The micrometer screw is then turned a predetermined increment, 0.001 in. or 0.002 in., a reading of the extensometer noted, the micrometer screw turned the same additional increment and the extensometer reading again noted. This procedure is followed throughout the range of the extensometer. The data obtained are then plotted using the micrometer readings as ordinates and the corresponding extensometer readings as abscissæ. The scale used in plotting the data should best be selected so that the scale for the abscissæ or extensometer readings is as many times as large as the ordinate scale as the lever multiplication ratio of the extensometer. This will make the resultant curve have an angle of 45 deg. with the X- and Y-axes, if the extensometer is correct.

A sample calibration is shown in Fig. 5. This curve was drawn from data obtained in the calibration of a Riehle extensometer, using a 2-in. gage length. (See Table I.) Referring to the diagram, it is seen that the calibration curve A crosses the 45 deg. line. This indicates that the zero setting of the extensometer was at fault. By drawing a second line B, parallel to A and

TABLE I. CALIBRATION TEST DATA OF 2-INCH RIEHLE EXTENSOMETER

Micrometer Reading	Micrometer Difference	Dial Reading	Error
0.732	0.000	0.00000	0
0.730	0.002	0.00089	-0.00011
0.728	0.004	0.00190	-0.00010
0.726	0.006	0.00296	-0.00004
0.724	0.008	0.00400	0
0.722	0.010	0.00500	0
0.720	0.012	0.00602	+0.00002
0.718	0.014	0.00705	+0.00005
0.716	0.016	0.00800	0
0.714	0.018	0.00901	+0.00001
0.712	0.020	0.01000	0
0.710	0.022	0.01099	-0.00001
0.708	0.024	0.01200	0
0.706	0.026	0.01312	+0.00012
0.704	0.028	0.01413	+0.00013
0.702	0.030	0.01516	+0.00016
0.700	0.032	0.01621	+0.00021
0.698	0.034	0.01720	+0.00020
0.696	0.036	0.01825	+0.00025
0.694	0.038	0.01922	+0.00022
0.692	0.040	0.02018	+0.00018

passing through the origin, we get the true error of the extensometer. This curve shows that the extensometer gives measurements which are 2 per cent too large. To correct this error, it would be necessary to shorten one of the levers of the extensometer by 2 per cent.

If the multiplying ratio of the extensometer being calibrated is not correct, and the scale, dial or micrometer screw of the extensometer is correct, the resultant curve will be a straight line but will not make an angle of 45 deg. with the axis. In such a case a way can usually be found for changing the multiplication ratio of the extensometer.

By observation of the calibration curve it is easy to see whether the multiplying ratio should be increased or decreased. If the observed readings cause the curve to make an angle greater than 45 deg. with the X-axis, the multiplying ratio should be increased; if less than 45 deg., the ratio should be decreased. After making a slight known change in the ratio, usually by increasing or decreasing the length of one of the levers, a second calibration of the instrument is made. From the two calibrations and the known amount of alteration in the levers it is comparatively easy to make a second definite change in the levers which will cause the instrument to read correctly. The instrument, however, should be checked with another calibration after the final adjustments are made.

When the calibration curve is not a straight line, it is due to (1) careless setting of the micrometer of the calibration device, (2) inaccuracy of the micrometer screw of the extensometer or of the dial of the extensometer (generally because of the eccentricity of the gears in the dial), or (3) to a combination of these causes. In any case the calibration should be repeated using care to see that the micrometer of the calibration device is accurately set. A small hand magnifying glass will be found useful in setting the micrometer head. If after these precautions have been taken and it is still found that the calibration curve is not a straight line, and that the discrepancy between the curve and the 45-deg. line is considerable, then account of this discrepancy will have to be taken in the data obtained in the use of the extensometer, or a new micrometer screw or an accurate indicating dial or scale will have to be provided for the extensometer.

It has been the experience of the writer that it is usually best to check all the lever motions and working joints of an extensometer before using the instrument in order to make sure that they work easily

without lost motion. Where the extensometer is provided with a micrometer screw for checking or calibration purposes, as in the case of the Ewing extensometer, the reading of this micrometer screw is used as an additional check on the reading of both the extensometer scale and the micrometer of the calibration device. Ten readings are usually considered sufficient for a single calibration.

New Kensington, Pa.

Local Heating With a "Pyrotip"*

In practically every line of manufacture some means of local heating is required for various operations. The most common form is the gas flame, using illuminating gas with or without compressed air. In fine work, as in jeweler shops, the alcohol lamp and blow torch are used. For portable work the gasoline blow torch is commonly used. For more intense heat the oxy-acetylene flame is employed, as well as the electric arc, using either carbon or metallic electrodes.

A convenient and economical method of local heating is obtained by using the Pyrotip, which is the trade name given to a low voltage transformer that has been specially designed for work of this nature. The secondary of the transformer furnishes sufficient current to quickly heat up the point of an ordinary $\frac{1}{8}$ -in. carbon rod. The voltage is so low that an arc cannot



PYROTIP, FOR LOCAL APPLICATION OF HIGH TEMPERATURES

be drawn, but the temperature of the carbon point can be varied through a wide range by simply altering the amount of contact surface at the end of the carbon.

The most evident field for this device is in the melting or joining of lead parts or terminals of storage batteries. Lead, unless a clean surface is obtained, cannot be readily melted with a soldering copper. Temperature control, especially for lead burning, is accomplished by altering the depth of submersion of the carbon tip in the molten lead. That portion of the carbon which is submerged assumes a temperature but little above the melting point of lead, 326 deg. C. Just above the surface the carbon is much hotter, approaching 1,200 deg. C. when submersion is $\frac{1}{8}$ in., and 700 deg. when immersed $\frac{1}{2}$ in. The greater energy put into the lead under these conditions is dissipated without leaving a high temperature because of the greater contact surface between the carbon and the lead. It permits the lead to carry off the heat and radiate it more rapidly.

In direct soldering, the hot point of the carbon burns the tin in the solder; so successful work involves "tinning" the surfaces by other means, and then placing the hot point somewhat back from the joint and heating

by conduction. The transformer can easily be used to heat soldering coppers by attaching a suitable holder to the low-tension terminals, and with advantage, since there is no danger of superheating and burning the end.

In jewelry stores a considerable amount of silver soldering is required in repairing broken silver spoons, gold rings, etc. The Pyrotip, utilizing a split or forked carbon electrode, is readily used. In this same line of work they have frequent need to melt down pieces of gold, silver, or platinum. The platinum works down in relatively small quantities, and it only takes a few seconds to melt down the platinum, whereas the gas ordinarily available requires a considerable length of time. It is also a simple proposition to utilize the same combination to melt down pieces of gold or silver from watch cases, putting them in small ingot form.

In the same way dentists can utilize the device for melting down old gold fillings, bringing them back to shape so that they can be used over again.

Dark glasses are desirable in this work, although not so essential as with other forms of local heating, due to the ease with which the eyes can be protected by properly manipulating the holder.

Recent Chemical & Metallurgical Patents

British Patents

For complete specifications of any British patent apply to the Superintendent, British Patent Office, Southampton Buildings, Chancery Lane, London, England.

Heat-Treatment of Rubber.—In the heat-treatment of rubber for reforming or vulcanizing, a solution is employed having its boiling point at or slightly above the temperature required, the solution being at or slightly below boiling point. Solutions of calcium chloride of various strengths are preferred, the boiling points of which rise approximately 10 deg. F. for every half-pound of salt to $1\frac{1}{2}$ pints of water. Several forms of apparatus are described. Articles or molds containing them may be immersed directly in the liquid, or placed in a jacketed vessel, the jacket of which contains the solution directly heated or circulated from an outside heater. Hollow bodies may have the hot solution pumped into their interiors. (Br. Pat. 161,648; H. GARE, Hazel Grove, Stockport, Cheshire. June 8, 1921.)

Recovering Tin From Scrap.—Tin scrap is treated with oleum to dissolve the tin, and the material is then lifted out of the acid and washed in water. Fresh acid is added to replace that used, and another batch is treated. After a time a basic sulphate SnSO_4 , SnO_2 deposits and is drawn off. The washing water contains some insoluble oxide, SnO_2 , and some tin in solution. The dissolved tin is recovered by precipitation as sulphide or iron is added to neutralize the acid and obtain metallic tin. External heat is not required in the process, but the acid bath is maintained by the exothermic heat and the periodical additions of fresh acid at a fairly constant temperature of 45-55 deg. C. and a strength of about 10 per cent free sulphur trioxide. (Br. Pat. 161,654; P. A. MACKAY, London. June 8, 1921.)

Pure Copper Sulphate.—Pure copper is dissolved in sulphuric acid or oleum in the presence of a soluble compound of a metal electro-negative to copper such as silver or mercury, or selenium. The electro-negative element may be added to the acid and then a solvent for it, such as nitric acid for silver or mercury. When blister copper is employed as raw material, one of its impurities may be used as catalyst, the necessary solvent, say nitric acid for silver or hydrochloric acid for selenium, being added. If an excess of copper is employed, the electro-negative metal used and any gold or silver in the copper are deposited on the excess

*From an article by E. A. Wagner in the *General Electric Review*, vol. 24, p. 628 (July, 1921).

copper and may be recovered. The process may be employed for refining copper. (Br. Pat. 161,656; P. A. MACKAY, London. June 8, 1921.)

Preparation of Oxyaldehydes.—Oxyaldehydes are prepared by the interaction of phenols or their derivatives with formaldehyde in the presence of a nitroso compound and a condensing agent. Preparation of vanillin by treating guaiacol and formaldehyde with *p*-nitrosodimethylaniline is described. Nitroso compounds specified are nitrosobenzene, nitrosonaphthalene, and *p*-nitrosodimethylaniline, hydrochloric acid being mentioned as condensing agent. (Br. Pat. 161,679; SOC. CHIMIQUE DES USINES DU RHONE, Paris. June 8, 1921.)

Organic-Mercuric Compounds.—Water-soluble derivatives of salicylic acid containing nuclear mercury are obtained by treating hydroxy-mercuric-salicylic acid anhydride or the like with a soluble cyanide at moderate temperatures and separating by fractional crystallization the resulting *o* and *p* compounds of the formula $\text{NC.Hg.C}_6\text{H}_4\text{OH.COOR}$, where R may be potassium. The reaction may be effected with cooling and in the presence of such quantity of water that both salts are separated, the liquid being iced before filtering. The product may be washed on the filter successively with ice water, 50 per cent alcohol, and concentrated alcohol, and lixiviated with three times its weight of water at 25 deg. C., to extract the more soluble *p*-compound, the residual *o*-compound being then recrystallized from hot water. Alternatively, the reaction may be effected in the presence of more water at ordinary temperatures; after heating, the *p*-compound is found in the solution and the *o*-compound remains undissolved. By adding acids to the aqueous solutions of the potassium salts the free acids may be precipitated. The silver salts may be prepared by adding silver nitrate. The potassium salts are suitable for therapeutic use. (Br. Pat. 161,922; not yet accepted; J. D. RIEDEL AKT. GES., Berlin. June 8, 1921.)

Treating Lead Zinc Ores.—Argentiferous lead-zinc sulphide ores are roasted with a halogen salt such as sodium, potassium, calcium or magnesium chloride in an oxidizing atmosphere at a temperature above 400 deg. C. but not high enough to volatilize lead chloride, the zinc sulphide remaining for the most part unattacked. To prevent any appreciable attack on the zinc the temperature should not exceed 500 deg. C. The air employed in the roasting is preferably moistened if dry. The product of the roasting is leached with hot brine to extract lead, some silver and any zinc chloride. The lead and silver are recovered in known manner—for instance, by cooling the solution and treating the deposited chlorides to separate the silver as argentiferous lead sulphate, the brine being used repeatedly. The residual ore is treated with a solvent for silver such as a solution containing 35 per cent calcium chloride and 3 to 5 per cent cupric chloride or 3 per cent hydrochloric acid or, if there is appreciable quantity of lead, the ore is first treated with hot brine containing hydrochloric or sulphuric acid to extract the lead. The used brine containing sodium sulphate and the lead salts obtained may be treated to desulphate the brine and obtain lead sulphate. In a modification, if there is some unoxidized lead sulphide remaining after the roasting or after the leaching with brine, the ore is leached with hot strong solution of calcium or magnesium chloride containing enough hydrochloric acid to convert the lead sulphide into chloride. This effects a good extraction of the silver and renders a subsequent extraction unnecessary. It is preferred to have a small quantity of zinc chloride present in the calcination, which may be derived from the ore if it contains some easily attackable zinc or may be added at the beginning or toward the end of the calcination, preferably as a mixture of sodium and zinc chlorides obtained by evaporating some of the brine used for leaching. (Br. Pat. 162,026; F. E. ELMORE, Boxmoor, Hertfordshire. June 15, 1921.)

Purifying Zinc Solutions.—A zinc-sulphate or other zinc solution is freed from foreign metals by treatment in the presence of a mercury salt with a subdivided metal electro-positive to the impurities. Zinc, aluminum and alloys thereof are suitable electro-positive metals; they may be powdered or granulated, zinc fume or blue powder being

advantageous. The mercury as mercuric chloride or nitrate, or, when zinc is to be electro-deposited, as mercuric sulphate, may be added as a solution or directly dissolved in the zinc solution before the treatment or at any suitable prior stage. Two pounds of mercury in the form of sulphate, and 40 lb. of zinc, suffice for 10 tons of crude zinc solution. This may be obtained from ore by treatment with spent electrolyte or other solution, and before the purification is brought to an acidity of 0.1 to 0.2 per cent, by means of incomplete neutralization, or by neutralization for the removal of silica, etc., followed by acidification. During the purification the liquid may be heated to 70-100 deg. C. and gently agitated. Copper, arsenic, antimony, bismuth, cadmium, nickel, cobalt and other metals are precipitated as a sludge, from which mercury can be recovered by distillation or otherwise. Iron may be removed before or after the above purification. If aluminum is used as the electro-positive metal, it may be subsequently removed, but is not injurious in the electro-deposition of zinc. (Br. Pat. 162,030; S. FIELD and METALS EXTRACTION CORPORATION, both in London; June 15, 1921.)

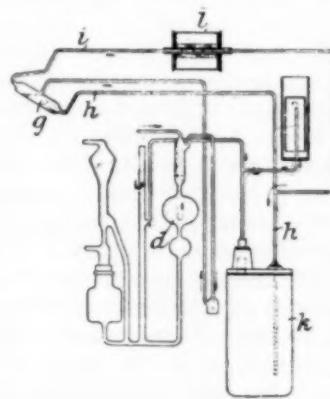
Spongy India Rubber.—In the manufacture of porous expanded india rubber by vulcanization in an inert gas under high pressure, a wax or resinous substance, such as ceresin, is added to the ingredients to minimize the diffusion of gas from the spongy mass. The wax or resin may be omitted from the outer layer, which then gradually loses its gas and forms a resilient skin which prevents excessive expansion of the interior mass. The ingredients are



placed in a shell 1 surrounded by an outer vessel 8, which is provided with a heating-jacket 15. Compressed gas is admitted to the vessel 8, and when a certain pressure is attained adjustable automatic valves in the passages 6 admit the gas to the inner shell. Heat is then applied, and temperature and pressure are gradually increased to the maximum values of about 305 deg. F. and 75 atmospheres. When vulcanization is complete, the temperature is first somewhat reduced and then the vessel 8 is rapidly exhausted. The automatic valves at 6 retain a pressure of about 100 lb. per sq.in. in the shell 1, which is allowed to remain until the product has cooled and is then released. A mixture of rubber and balata may be substituted for pure rubber if desired, but the proportion of rubber should not be less than one-third. (Br. Pat. 162,176; C. L. MARSHALL, Harlesden, London; June 15, 1921.)

Analyzing Gases.—Apparatus for carrying out two series of analyses is so arranged that in both series at least one constituent of the gas is always included; for example, in one series the percentage of carbon dioxide is determined, and in the other series the total percentage of carbon dioxide, carbonic oxide, hydrocarbon and hydrogen. The two series of analyses may be recorded on a common diagram, the recording device being so constructed that alternate lines correspond to the two series of determinations. As shown, the first measuring-vessel *d* is connected to an oscillating vessel *g* containing liquid and which according to the position of the vessel seals one or other of the pipes *h*. The apparatus consists of a furnace *l* connected to an oxidizing furnace *l* and then to the absorber *k* for recording the percentage of carbon dioxide, carbonic oxide, hydrocarbon and hydrogen. (Br. Pat. 162,249, not yet accepted; SVENSKA AKTIEBOLAGET MONO, Stockholm; June 15, 1921.)

h, i, j; the sample therefore passes alternately to the absorber *k* when the percentage of carbon dioxide is to be determined, and to the oxidizing furnace *l* and then to the absorber *k* for recording the percentage of carbon dioxide, carbonic oxide, hydrocarbon and hydrogen. (Br. Pat. 162,249, not yet accepted; SVENSKA AKTIEBOLAGET MONO, Stockholm; June 15, 1921.)



Current Events

in the Chemical and Metallurgical Industries

Important Papers to Be Presented at the Seventh National Exposition of Chemical Industries

At the Seventh National Exposition of Chemical Industries, which will be held during the week of Sept. 12, 1921, in the Eighth Coast Artillery Armory, New York City, important papers will be presented on: Crushing, Grinding and Pulverizing; Evaporating and Drying; Power Plants in the Chemical Industries; Paints and Varnishes, and Industrial Problems. There will also be shown a series of motion pictures on subjects related to chemical and mining industries, handling of materials, and power plants.

The papers to be presented, according to the tentative program, are:

SEPTEMBER 13, 1921

Crushing, Grinding and Pulverizing

H. F. Kleinfeldt (Abbe Engineering Co.), "Ball and Pebble Milling for Pulverizing and Mixing."

S. B. Kanowitz (Raymond Bros. Impact Pulverizer Co.), "Grinding and Pulverizing With Air Separation."

L. H. Sturtevant (Sturtevant Mill Co.), "Crushing and Grinding Phosphate Rock."

M. I. Dorfan (Allis-Chalmers Mfg. Co.), "Dust Collection as Applied to Grinding and Pulverizing Problems."

H. Schiffelin (Allis-Chalmers Mfg. Co.), "The Development of Compound Grinding Mills."

Industrial Problems

H. Austin (Ernest Scott & Co.), "Solvent Extraction of Edible Fats and Oils."

R. H. McLain (General Electric Co.), "Material Handling in Industrial Plants."

SEPTEMBER 14, 1921

Evaporating and Drying Program

E. G. Rippel (Buffalo Foundry & Machine Co.), subject to be announced later.

A. E. Stacy, Jr. (Carrier Engineering Corp.), "The Relation of Atmospheric Conditions to Chemical Processes."

H. S. Landell (Proctor & Schwartz), "Drying and Drying Problems."

Max Donauer (Elyria Enamelled Products Co.), "Special Problems for Enamelled Evaporators."

Arthur B. Stonex (Hunter Dry Kiln Co.), "Drying With Moist Air."

A. W. Lissauer (W. L. Fleisher & Co., Inc.), "Drying as an Air-Conditioning Problem."

J. D. Stein (Grinnell Co., Drier Division), "Atmospheric Drying by Means of Compartment, Tunnel and Continuous Belt Conveyor Driers, With Some Practical Applications."

W. H. Dickerson (Industrial Waste Products Co.), "Spray Drying."

H. Austin (Ernest Scott & Co.), "Evaporation."

SEPTEMBER 15, 1921

Paint and Varnish Program

R. S. Perry, Chairman.

H. A. Gardner (Institute of Paint and Varnish Research), "Reflection Factors on Industrial Paints."

L. P. Nemzck (Du Pont de Nemours & Co.), "Laboratory Control."

R. S. Perry (Perry & Webster, Inc.), "Paint and Varnish Waste Control."

Maximilian Toch (Toch Bros.), "Rust: Its Cause and Prevention."

Frank G. Breyer (New Jersey Zinc Co.), "Physical Testing of Paints and Paint Materials."

F. P. Ingalls (John W. Masury & Co.), "The Ideal Paint and Varnish Specification."

Ernest T. Trigg (Chairman, "Save the Surface" Committee, Paint Manufacturers Association of the U. S.), "Save the Surface and You Save All With Paint and Varnish."

G. B. Heckel (Secretary, Paint Manufacturers Association of the U. S.), "What Is Paint?"

SEPTEMBER 16, 1921

The Power Plant in the Chemical Industries

R. C. Beadle (Editor, *Combustion*), Chairman

R. M. Gordon (Solvay Process Co.), "Modern Boiler House Arrangement and Equipment" (illustrated).

John Primrose (Power Specialty Co.), "Suggestions for Reducing Heat Losses in Chemical Plants."

E. G. Bashore (Rice & Bashore), "Boiler Feed Water Treatment and Treatment Control."

A. R. Stevenson, Jr. (General Electric Co.), "Compressed Air Installation in Industrial Plants."

D. B. Rushmore, J. A. Seede and E. Pragst (General Electric Co.), "The Application of Electric Power in the Chemical Industry."

D. D. Chamberlin (Distillation Industries, Inc.), "A New Method for Coking Coal as Required for Industrial Fuel."

F. G. Anderson (Morse Chain Co.), "The Limitations of Silent Chain Drive."

The motion pictures to be shown are:

CHEMICAL INDUSTRIES

"The Story of Sulphur" (2 reels), Courtesy Texas Gulf Sulphur Co.

"Making Soap" (1 reel), Courtesy Baumer Films.

"Manufacture of Dynamite" (1 reel).

"Manufacture of Pyrex Glassware" (3 reels), Courtesy Corning Glass Co.

"Manufacture of Portland Cement" (2 reels).

"The Jewels of Industry" (8 reels), Courtesy the Carborundum Co.

(a) Creating Power From Water.

(b) Within the Power Plant at Niagara.

(c) In and About Niagara Falls.

(d) Power at Work in the Carborundum Plant.

(e) Making the Crystal Masses in the Electric Furnace, and

(f) Making Them Into Stones, Grinding Wheels, Paper and Cloth.

(g) Usual and Unusual Uses for Abrasives in Some Fifty Industries.

"The Electric Heart—The Dry Cell" (1 reel), Courtesy Baumer Films.

"Canning Electricity—The Wet Cell" (1 reel), Courtesy Baumer Films.

"The Making of Oleomargarine" (1 reel), Courtesy Armour & Co.

"The Manufacture of Dry Sausage" (2 reels), Courtesy Armour & Co.

"Du Pont Dyes"—showing their manufacture (2 reels), Courtesy Du Pont de Nemours & Co.

MINING AND THE CHEMICAL INDUSTRIES

"The Story of Rock Drilling" (4 reels), Courtesy Sullivan Machinery Co. and U. S. Bureau of Mines.

"Iron Mining Operations" (4 reels).

(a) Stripping.

(b) Exploration and Stripping.

(c) Underground Mining.

(d) Logging Operations.

"The Story of the Armco Ingot Iron" (3 reels), Courtesy American Rolling Mill Co.
 "Mining Magnetic Iron Ore" (2 reels).
 "Zinc Mining, Milling and Smelting" (4 reels).
 "Manufacture of Zinc Oxide" (1 reel).
 "Mining and Extraction of Radium From Carnotite Ore" (3 reels).
 "Mine Explosion and Rescue" (1 reel).
 "Exterminate the Mosquito" (1 reel).

HANDLING OF MATERIAL

"Saving Wasted Millions Through Material-Handling Equipment" (2 reels), Courtesy Economy Engineering Co.
 "Use of the Steam Shovel in Mining" (1 reel).
 "Transportation and Storage of Iron Ore" (1 reel).
 "Transporting and Handling Coal by Various Means" (1 reel).
 "Dredging Anthracite Coal" (1 reel).

THE POWER PLANT

"Conserving Coal and Saving Heat Values by Regulating Steam Pipes and Boilers" (1 reel), Courtesy Magnesia Association of America.

"The Cost of Careless Firing" (2 reels).
 "Getting the Most Out of Coal" (1 reel).
 "Modern Byproduct Coking" (2 reels), Courtesy the Koppers Co.

All films not otherwise credited are by courtesy of U. S. Bureau of Mines.

Senate Committee Busy on Tariff Bill

The greatest uncertainty prevails, as this is written, as to what the Finance Committee of the Senate may do in regard to protection for the dye industry. It is recognized by all who are following the matter closely that the committee is almost evenly divided on the subject. The most determined efforts have been made to convince the committee that the limited embargo plan is absolutely necessary to the maintenance and growth of this new American industry. On the other hand, the opposition has been equally energetic in the presentation of its contentions. It is admitted by each group that the action of the committee is anyone's guess.

Almost the same situation exists with regard to American valuations. In regard to that portion of the tariff bill, however, there seem to be more who believe that the committee will reject the scheme as it is carried in the House bill, with the probability that the committee will favor the Davis modification. During the hearings the committee seems to have been impressed by the arguments that the American valuation plan as passed by the House will be impracticable of administration in its application to many commodities, and that it will lay an intolerable burden on the appraiser. The committee also seemed to be impressed adversely by the prospect of price pyramiding in certain commodities. On the other hand, the committee has a thorough understanding of the difficulties and inequities certain to come from foreign valuations under existing conditions.

COMMITTEE INSISTS ON FACTS

An idea of the rather grueling character of cross-examination to which some of the witnesses before the Finance Committee were subjected may be obtained from the following extract from the stenographic report of the testimony of Henry Howard:

Senator REED. Do you believe that an article that can be sold abroad in competition with the world needs protection in America against foreign products?

Mr. HOWARD. I can imagine that there would be cases where it would need it.

Senator REED. Why?

Mr. HOWARD. To prevent dumping over here.

Senator REED. That is the only thing you can think of?

Mr. HOWARD. To prevent methods of unfair competition.

Senator REED. But if unfair competition could be employed in our markets, it could be employed against us abroad at the same time, could it not?

Mr. HOWARD. It could, but might not be.

Senator REED. You really want it so that the American manufacturer can sell in America on a high level and then dump his surplus in Europe?

Mr. HOWARD. I think that is probably a desirable thing to have.

Senator REED. Undoubtedly. I thought so.

Mr. HOWARD. And I think that it is the way it is generally tried to carry it out abroad, also.

Senator REED. That is to say, the American people must have a tax levied upon everything that we consume in order that the manufacturer can sell to them at a high price and sell abroad at a low price.

Mr. HOWARD. These conditions carried out to a reasonable extent make for the prosperity of the American people by enabling us to pay high wages.

Senator REED. And, carried out to a reasonable extent, you mean carried out far enough so that the American manufacturer makes a good fat profit here—

Mr. HOWARD. Makes a fair profit. Internal competition will prevent his making too big a profit.

According to some of the members of the committee, the arguments for or against duties have been composed too greatly of generalities. Senator Reed believes that industries asking for protection should submit statements showing the wage rate to both skilled and unskilled labor; statements as to gross profits, net profits, dividends, surplus, amounts of excess profits and other data, which would make the determination of tariff rates more intelligent.

TESTIMONY OF CHEMICAL MANUFACTURERS

A. G. Rosengarten, of Philadelphia, appeared before the committee to request a compensatory duty on mercurial preparations, since the House of Representatives increased the rate on quicksilver from 7c. to 35c. per lb. He suggested that the compensating duty on calomel, corrosive sublimate and other mercurial preparations should be 25 per cent ad valorem and 32c. per lb. Mr. Rosengarten also protested against the duty of 7c. per lb. placed on citrate of lime by the House. He pointed out that this is the crude material for the manufacture of citric acid on which a duty of 12c. per lb. was placed. Mr. Rosengarten argued that should those duties become effective, the Eastern manufacturers of citric acid would be compelled to close their works. Since 2 lb. of citrate of lime is required to make 1 lb. of citric acid, it would mean that the duty on the finished product is lower than the duty on the crude material. He suggested that not more than 2c. per lb. should be imposed on citrate of lime.

Frank Kidde, secretary of the Monmouth Chemical Co., protested against the proposed duty of 1c. per lb. and 15 per cent ad valorem on chlorate of potash. To have an ad valorem tariff on an American valuation basis, he said, would mean that the valuation would be based on a market value established by a single manufacturing group, which practically controls the manufacture of chlorate of potash in this country.

Dr. Max Mueller, of New York, asked that the photographic chemicals rhodal and metol be given rates of 30 per cent ad valorem and \$1.50 per lb. and 30 per cent ad valorem and 50c. per lb., respectively. These rates are necessary to protect two of the most widely used chemicals in the developing of photographic films, he stated.

Dr. Frederick W. Russe, of St. Louis, stated that 10c. per lb. is insufficient to protect the manufacture of medicinal tannic acid, and he asked for increased duty and a change in the method of classification.

A. S. Somers, representing the Association of Dry Color Manufacturers, pointed out the need for supplying specific duties for all colors and pigments derived from coal-tar products. He also called attention to compensatory duties which should be provided as a result of the increase in the rate of duty on quicksilver.

CANADIANS PROTEST

A very complete presentation was made by those interested in the chemical products made at Shawinigan Falls, in Canada. To enable Canadian industry to continue to purchase raw materials in the American market, Canadian finished materials cannot be barred entirely from the United States, it was argued. It was declared that Canadian glacial acetic acid is essential to the American dye and other

chemical industries if they are to compete in export markets. There are no producers of synthetic acetic acid in the United States, it was declared, nor is there any immediate prospect of this product being produced from acetylene gas synthetically, as now is being done in Canada. Glacial acetic acid, it was contended, should be left on the free list. To impose the 2c. per lb. provided by the House bill would penalize the American consumer, it was said, and place American dye and chemical industries at a distinct disadvantage in meeting competition abroad.

Ellwood B. Speare, representing the Goodyear Rubber Co., revealed that acetaldehyde and paraldehyde are being used with great promise in increasing the rate of vulcanization and for giving better quality to rubber. The use of these materials, he explained, is still in an experimental stage, and unless they can be obtained without payment of an excessive rate of duty he believes their use would have to be discontinued.

The Shawinigan industries also protested against a duty of 1c. per lb. on carbide. It was held that this rate is prohibitive. It would be impossible to ship to the United States if a duty of \$20 per ton were levied. It was stated that the item would yield no revenue and that it simply would have the effect of increasing the business of the Union Carbide Co. by about 15,000 tons annually.

Dr. H. C. Wright, representing the Manufacturing Perfumers' Association, argued against any embargo privileges for aromatic chemical products in that the question of quality is paramount. It is absolutely essential to successful competition, he declared, to have the very finest products. He also stated that very few of the aromatic chemical products listed in the bill are produced in America equal in quality to the foreign product.

J. D. C. Bradley, of the American Agricultural Chemical Co., opposed the duty on potash. Among other things, he said:

I do not believe that this country can successfully compete with German or French potash unless actual deposits of potash salts are discovered. The potash produced from the Nebraska lakes is low grade and inferior in quality to the German article either for direct application or for use in mixed fertilizers. The California product contains a certain amount of borax, which is deleterious to plant life, and this company is unwilling to risk its use. Other companies who have used it have suffered heavy losses in consequence of the borax injuring the crops. It is now claimed that the amount of borax has been reduced to a safe percentage, but of this fact we are not as yet sufficiently convinced to risk using it in our fertilizers.

I cannot believe that Congress will consent to levy a tax upon the products of the soil and indirectly upon the very sustenance of every citizen.

DYE EMBARGO ESSENTIAL TO NATIONAL DEFENSE

Chemical warfare is not likely to be restricted, even if limitation of armament should be agreed upon, in the opinion of General A. A. Fries, the head of the Chemical Warfare Service. He expressed this belief to the Finance Committee of the Senate in response to an inquiry by Senator Penrose, the committee chairman. General Fries was called before the committee to testify as to the national defense feature of the dye embargo. He contended that such an embargo is absolutely essential to the development of materials necessary to the national defense.

In expressing the conviction that there would be no restriction placed on chemical warfare by any disarmament limitation agreement, General Fries, among other things, said:

"Chemical preparedness is the only means of national protection which can be developed and maintained in times of peace without cost to the country. The disarmament conference may result in restricting the construction of battleships and big guns, since that would reflect large economies for all the nations concerned, but for the United States to cease to prepare for the manufacture of war gases would put us at the mercy of an outlaw nation."

DYE CONSUMERS PRESENT VIEWS

Not all consumers of dyes are opposed to the embargo plan. Daniel F. Waters, Philadelphia, was among those who urged its adoption. He stated that American makers

are perfecting their processes, are reducing their prices and will soon be in a position to give entire satisfaction. Practically all of the consumers of dyes, however, opposed the plan, largely on the ground that it is impossible to get the necessary quality in most dyes of American manufacture. It was admitted that a few American dyes equal the German product, but that the great majority of the colors are not fast. Alfred A. Hodshon, a manufacturer of felt hats, declared that it had been necessary for his company to revolutionize its manufacturing methods so that hats could be dyed after they are molded. When German dyes were available, the dyeing was done before the molding process. He declared that American-made colors will not hold throughout the manufacturing process.

The committee apparently was impressed more by the testimony showing the delays and difficulties of securing importations, or even rulings, through the War Trade Board procedure, than it was by the statements as to lack of quality. The committee seems confident that American manufacturers will be able to attain the necessary quality standards, but very evidently is extremely dubious as to the practicability of any such administration as it is proposed to vest in the United States Tariff Commission.

Chemical Exposition Notes

MINERALS, METALS AND ALLOYS

To the user of minerals and metals the Seventh National Exposition of Chemical Industries, which will be held in the Eighth Coast Artillery Armory, New York, Sept. 12 to 17, offers exceptional possibilities for actual investigation, study, technical information and advice, whether it be a new alloy or the more precious metals.

There is, for instance, an alloy discovered in 1905. The average brass foundryman, after finding out that the metal had a fair percentage of copper, decided that it ought to be a simple proposition and proceeded to cast it in the same manner as he would brass. As a matter of fact it is difficult to cast. It is much more sensitive to oxidation, has a higher shrinkage, and demands a much larger percentage of metal in the gates and risers. It must be kept carefully covered and must be deoxidized before pouring. These difficulties are gradually being overcome, through the education of the foundrymen, especially through a plant service station where foundrymen can go for advice and information, where they may familiarize themselves with the use of the metal.

This particular metal is non-corrodible, strong as steel, tough and ductile. It can be machined, forged, soldered and welded both electrically and by the oxy-acetylene process.

There are many cases where ignorance of the best methods to employ in working with individual alloys or minerals with peculiar properties has prevented the best results or advantages to be obtained with these metals.

There will be a splendid exhibit of minerals, metals and alloys at the exposition, where the highest knowledge and experience of the chemical world will be at the command of any investigator.

Acting Chief Named for Bureau of Chemistry

Expecting that some time yet may elapse before the new chief of the Bureau of Chemistry will be selected, the Secretary of Agriculture has designated Walter G. Campbell as the acting chief of that important bureau of the Department of Agriculture. Dr. W. W. Skinner was designated at the same time to be assistant chief.

Mr. Campbell has been with the Bureau of Chemistry since 1907. He helped to organize the inspection work under the food and drugs act. In 1916 he was made assistant chief in charge of the enforcement of the food and drug regulations. He is a native of Kentucky and a graduate of the University of Kentucky.

Dr. Skinner is an agricultural chemist and has been with the bureau since 1904. He formerly was a member of the chemical staff of the Maryland Agricultural College. He has been charged with the enforcement of the beverage regulations promulgated in connection with the food and drugs act. He is a native of Maryland and was graduated from the Maryland Agricultural College and from George Washington University.

Transportation Arrangements for the British Chemists

The members of the Society of Chemical Industry of Great Britain and those of the Canadian Section who are to participate in the international session to be held on Sept. 8, in New York City, will enter the United States at Niagara Falls and on the evening of Sept. 5 will go by special train to Syracuse, where they will inspect the plant of the Solvay Process Co. The next day they are to proceed in the same cars to Albany, where connections will be made with the night boat "Berkshire," upon which accommodations for 150 have been reserved. The party will arrive at New York early the next morning, in time for the society meetings.

Members of the societies desiring to obtain accommodations on this train and on the boat, and who have not already made arrangements with their local officers, should advise Charles F. Roth, chairman of transportation for the co-ordinating committee, 52 East 41st St., New York, before Aug. 20. For members returning via the same route, a special fare upon the following certificate plan will apply.

The Trunk Line Association and the Southeastern Passenger Association have granted special rates equivalent to a fare (one way) and a half to those traveling from within their territories. Tickets can be purchased and used from Sept. 6, and the return coupon is good until midnight of Sept. 23. To obtain this reduced fare an identification certificate (which will be furnished upon application to C. L. Parsons, secretary, A.C.S., 1709 G St., N. W., Washington, D. C., or Allen Rogers, secretary, Society of Chemical Industry, Pratt Institute, Brooklyn, N. Y., respectively for these members) will be necessary and will suffice for each member, including his family.

Accommodations and arrangements for the entertainment of the visitors are in the hands of the co-ordinating committee of the American Chemical Society, with whom they are to hold the joint scientific sessions. It is expected that many of the chemists will bring their wives and daughters, and accordingly the ladies' entertainment committee, of which Mrs. L. H. Baekeland, of Yonkers, is the chairman, has an unusually complete organization and is making elaborate preparations for the entertainment of the ladies.

PROMINENT SCIENTISTS EXPECTED

At the head of the overseas delegation will be Sir William J. Pope, K.B.E., F.R.S., president of the Society of Chemical Industry, who two years ago was knighted for his valuable services in the production of mustard gas.

Among other prominent members will be Dr. Louis A. Jordan, Chevalier of the Crown of Italy, who was sent to aid the Italian Government in the making of explosives; Dr. Frederick William Atack, whose principal work has been the chemistry of dyes; Dr. Andrew McWilliams, one of the best-known steel metallurgists in Great Britain, and Dr. Andrew Smith, an explosives engineer of international reputation.

Some of the eminent Canadian chemists will be: Dr. R. F. Ruttan, past president of the Canadian Section of the society, chairman of the Advisory Council of Scientific Research and formerly vice-president of the parent society; Dr. Milton L. Hersey, one of the founders and past chairman of the Canadian Section, and Dr. C. R. Hazen, chairman of the Montreal Section.

Ceramics Work Being Expanded

Fully \$60,000 will be expended during the next twelve months at the ceramic experiment station of the U. S. Bureau of Mines at Columbus, Ohio. This sum includes with the Federal appropriations the amounts which have been contributed by industries interested in the research. In addition to the regular work of the station, the experimentation on heavy clay products and on the Georgia kaolins will be conducted at the Columbus station.

Due to the increased importance of the work at Columbus L. I. Shaw, the assistant chief chemist of the bureau, has been transferred to Columbus as chief assistant to the superintendent of the station. The vacancy in the Washington office has been filled by the designation of Dr. Andrew Stewart to act as assistant chief chemist.

Synthetic Organic Chemicals Defined

The Treasury Department has recently issued important regulations for the enforcement of the dye and chemical control section of the emergency tariff act of May 27, 1921. Among the provisions of interest to the chemical industry may be found the following:

The terms "synthetic organic chemical and synthetic organic drug," used in said section 501-a of the emergency tariff act are interpreted to apply to any substance which is known commercially as a chemical or drug and which contains carbon in chemical combination with other elements (excepting cyanides, cyanamides, carbides, carbonates and bicarbonates of metals or inorganic radicals), and which has been produced by any chemical process other than that necessary to extract, isolate or purify the substance from a natural source or to effect its separation from a more complex natural compound by hydrolysis or to form a salt.

Products obtained by fermentation, if such fermentation is carried on under controlled conditions, are considered to be synthetic organic chemicals. Distillation which simply separates a substance already formed from other substances does not make the product of such simple distillation a synthetic chemical or drug, but if the substance is subject to destructive distillation the products of such destructive distillation are considered to be synthetic organic chemicals or drugs.

In those cases where a particular substance may be either a natural or synthetic product it should be assumed that the substance is a synthetic product if it is known that the product produced is of a substantial commercial quantity. In cases of doubt the question will be referred to the department.

It is held that compounds or mixtures in part of coal-tar origin are included in the term "mixtures and compounds of such coal-tar products" as it occurs in the act, and that it was not the intent of the act to limit the term to mixtures and compounds wholly of coal-tar origin. When a product has sufficient coal-tar product mixed or combined with it to change materially its identity or character it shall be considered a "mixture or compound of such coal-tar product" within the meaning of the act.

American Peat Society to Meet in New York

The fifteenth annual convention of the American Peat Society will be held at the Hotel Commodore, in New York City, on Sept. 7, 8 and 9. Addresses will be made by well-known peat specialists of the United States and Canadian governments, by soil experts of various state experiment stations and by others interested in the engineering and bacteriologic aspects of the world's peat deposits. The program will include discussions of air-dried machine and powdered peat fuel, the cultivation of peat soils, the application of bacteriology to soil fertilization, the use of peat as a nitrogenous ingredient and conditioner of fertilizer and stock feed, the efficient handling of peat, false promotion, inefficient engineering and other subjects. An important announcement concerning the status and prospects of the industry and the society will be made by one of the officers. At the close of the meeting an opportunity will be given to visit one of the largest and most efficient peat plants in the world and to see the products being produced in commercial quantities.

French Edition of Specifications Now Available

The U. S. Department of Commerce has completed the translation and publication of the French-English edition of 61 A.S.T.M. specifications particularly applicable to export trade. These specifications form part of the Industrial Standard Series, of which the Spanish-English editions of the same specifications were the beginning. The specifications include those for rails and splice bars, structural and reinforcing steels, steel forgings and castings, steel wheels and tires, steel and iron tubes and pipe, boiler steels, wrought-iron products, pig iron, cast-iron pipe, malleable and gray-iron castings, copper wire, copper bars, spelter, bronze, cement, linseed oil and turpentine. Copies are being distributed by the Government to commercial attachés and trade commissioners, and arrangements for distribution in other channels are being considered. Copies of the specifications may be obtained by addressing the Superintendent of Documents, Washington, D. C.

New Bureau of Standards Standard Samples

A new standard sample of lead-base bearing metal No. 53 is now being issued with a provisional certificate. This sample has the approximate composition: Lead 79 per cent, tin 11 per cent and antimony 10 per cent, and contains in addition small amounts of bismuth, copper, iron and arsenic. The price of this sample is \$2 per 150 g., prepaid or parcel post c.o.d.

Renewal No. 33a of nickel steel No. 33 is also ready for distribution at the price of \$2.50 per 150 g.

Book Reviews

COPPER REFINING. By Lawrence Addicks. 6 x 9 in., 211 pages. New York: McGraw-Hill Book Co., Inc. Price, \$3.

If one had been asked six months ago where to find information on electrolytic refining of copper, he would have been somewhat at a loss. About the only English text on this subject, T. Ulke's "Modern Electrolytic Copper Refining," was written 20 years ago and has been out of print for some time. Texts on general metallurgy, and even treatises on the metallurgy of copper, present only the barest outline of refinery practice. For instance, Peter's "Modern Copper Smelting" contains a chapter dating from the 90's, and his later books seem to avoid the subject. Schnabel is useless. Gowland's excellent "Metallurgy of the Non-Ferrous Metals" compresses the matter into six pages.

Since Ulke's book has appeared, therefore, the only additional information available consists of articles scattered through the technical press, with perhaps the sole exception of Burns' monograph on the Great Falls Refinery.¹ Hansen, of the General Electric staff, also prepared a detailed consideration of the underlying electrochemistry (unfortunately not yet printed). Beyond this, one was forced to rely upon Greenawalt's "Hydrometallurgy of Copper," and Tobelmann's accounts of operations at Ajo.² The latter are discussing a fundamentally different problem, however; that of depositing pure copper from a sometimes impure solution, while the problem of electrolytic refining is to convert low-grade copper into one of highest purity.

It is therefore apparent that here existed a considerable gap in metallurgical literature. But to fill it was what might be called a labor of love, since it would circulate only among the more important technical libraries, and the relatively minute number of men occupied in this branch of copper production—there are only 11 refineries handling any important tonnage in the Western Hemisphere. Nevertheless the labor has been well done.

Addicks approaches the subject from an entirely different viewpoint than did Ulke. The latter neglected the chemistry and physics of the process and successfully attempted a symposium of refinery practice, showing how the various plants were laid out, and describing the minutiae of their construction. In many cases one was left wondering what reasons led to the choice of certain detail at Perth Amboy and another at Baltimore. Addicks, on the other hand, views the process from a managerial standpoint. His Chapter V on "Current Efficiency" is an instance. Current efficiency is first defined, then nine sources of loss are listed and discussed in detail. Any or all of them may be kept to a very low amount by means which are noted or are self evident to a competent designer reading the text, so that an efficiency of 99 per cent can be had if expense is no item. Good balanced operation approaches nearer 92 per cent. It is the 92 per cent which interests Addicks, and he emphasizes that a gain over this figure must not cost in other departments more than the coal it saves.

A further notable feature of the text is the pronounced stress the author places on an expense seldom mentioned, but nevertheless most important. This refers to the interest on metals tied up in the process. Such an item is of

greatest importance when figured against precious metals contained in the sludges, but an enormous mass of cheaper copper worth a far greater sum of money circulates perpetually through the plant, always in solution. Modifications to present practice are continually directed toward a reduction of this locked-up value.

A considerable portion of the text has been published serially in CHEMICAL & METALLURGICAL ENGINEERING during the last five years. Nevertheless, our readers will recognize the desirability of having the articles collected in a form handy for reference. The treatment of the subject is such that not only copper refinery men, but every engineer or chemist working with the electrodeposition of metal from aqueous solution, will get many valuable suggestions which he can apply directly to better his work. E. E. THUM.

Personal

W. M. BERRY of the Bureau of Standards, A. I. PHILLIPS of the American Gas Association and H. A. STRAUS, chief engineer of the Public Service Commission of Maryland, are the committee of engineers to investigate for the Maryland Public Service Commission the desirable quality of gas to be required in the city of Baltimore. Extended experiments on the efficiency of use and on other features bearing upon the general matter will be carried out in Baltimore jointly by the commission, the Baltimore Consolidated Gas & Electric Light Co. and the Bureau of Standards.

RAYMOND T. BOHN has been appointed chief chemist of the Nicetown plant of the Midvale Steel & Ordnance Co., succeeding Dr. G. L. Kelley, resigned.

S. A. COVILLE, gas engineer of the Maryland Public Service Commission, is to visit Canada and Europe investigating the influence of the standards for gas quality which have been adopted in those countries on the service to gas users. This work is in line with an extended investigation which the commission is now undertaking regarding the quality of gas to be required in Baltimore.

H. C. DICKINSON, who has been for some years chief of the automotive investigations division of the Bureau of Standards, has been granted a year's leave of absence from the bureau to become director of research of the Society of Automotive Engineers. He will, however, continue in some measure to co-operate in the Bureau of Standards' investigations by giving a small amount of his time to conference and direction of the work of this division. Work of the S.A.E. on research will not include any experimental investigations by the society itself, but will deal rather with an exchange of research information, the general study of research in progress within the industry and of interest to it, and an effort to secure proper arrangements for additional research work which is not now adequately cared for.

B. M. LARSEN has been elected a fellow in the University of Washington for electrometallurgical work in the Bureau of Mines Station at Seattle, Wash.

E. A. RICHARDSON has resigned as a member of the glass technology department, National Lamp Works of the General Electric Co., Cleveland, Ohio, to accept the position of chief chemist for the Libbey Glass Manufacturing Co., Toledo, Ohio.

WILFRED W. SCOTT has resigned as research chemist of the General Chemical Co. to accept the position of associate professor of chemistry in the Colorado School of Mines.

BRADLEY STOUGHTON, having resigned after more than eight years' service as secretary of the American Institute of Mining and Metallurgical Engineers, will resume his practice as a consulting engineer, making a specialty of financial investigations and reports to bankers, investors, directors, trustees and examining accountants on industrial plants, engineering enterprises, and iron and steel plants. His address will be, until Oct. 1, Engineering Societies' Building, 29 West 39th St., New York City.

¹Transactions, American Institute of Mining Engineers, 1913, vol. 46, pp. 703, 196.

²Ibid, 1916, vol. 55, p. 830; 1919, vol. 60, p. 22.

Current Market Reports

The Chemical and Allied Industrial Markets

NEW YORK, Aug. 5, 1921.

Besides a slight tendency to show fractional declines, the chemical market during the past week showed signs of an early revival regardless of the mild inquiry due to the summer season. Producers of chemicals are getting business, and some of the largest interests say that the month just ended was responsible for the best volume of sales for any month of the year to date. Caustic soda has declined slightly on spot under the efforts of resellers to stimulate business. Soda ash seemed somewhat easier, but the change in spot quotations was of no importance. Producers of these two items have not announced any change in contract prices in the open market. Some of the leading caustic soda and ash plants are running as low as 15 per cent of normal, which is surely indicative that supplies are not increasing. Imported prussiate of soda experienced a period of competitive selling early in the week and business was placed at a shade under former quotations. Bichromate of soda seemed to withstand any forced selling and the market remained firm at former quotations. Bleach has attracted some interest at 2c. per lb. f.o.b. works in large drums. Foreign caustic potash has drifted slightly downward. Domestic oxalic acid is holding quite steady, with occasional slight concessions for foreign material. Sulphuric acid is moving quietly, with supplies sufficient to meet the present demand. Prices on sulphide of soda are steady enough for domestic goods, but the imported is being offered at lower prices. Camphor is moving at unchanged values. Barium chloride afloat was offered at \$47 per ton. Manufacturers of salt cake report sales as low as \$25 per ton, spot, in bulk lots. Copper sulphate has slackened somewhat since requirements for agricultural purposes have already been met.

INDUSTRIAL CONDITIONS IMPROVING

In the industrial world, all signs indicate that the period of liquidation of the raw material markets has passed. Recent changes are due mainly to conditions of supply and demand in specific lines. This is considered a normal condition. Wholesale prices of many classes of manufacturers have been fully deflated. This is not true in all lines, but recent cuts in the price of steel and widespread reductions in wages indicate that adjustment in wholesale prices will not be delayed much longer. Retail prices show wide irregularities and high-cost stocks have been largely disposed of. Price stabilization is undoubtedly not far ahead. The textile industry is progressing in admirable manner. The American Woolen Co. opened its spring sales at well-maintained prices and reported a larger volume of business than last year. There has been a slight improvement noted in the steel industry. Mill operations are reported having increased 5 per cent in the Pittsburgh region. Several mills that had been closed down for some time have reopened. Freight car loadings have shown a very decided increase during the past ten days. Although there were complaints of slack business and mid-summer dullness, bank clearings held up quite well. Clearings are not far below those of last year. This is a very good indication when taking into consideration that commodity prices are very much lower than they were at this time last year. In general, the consensus is that the fall season will see a decided turn to the better in the chemical industry.

CHEMICALS

Imported caustic soda, 88-92 per cent, is quoted in most directions at 4½@4¾c. per lb. Trading has not shown much activity during the past week and in some quarters it was intimated that a firm bid at 4¾c. would be accepted on a round lot. The latter figure is equivalent to the pre-war price on this material. Yellow prussiate of potash was offered

at lower figures by dealers and reports were current that small-lot sales have gone through on the basis of 2½c. per lb. The general range is from 2½@2¾c. per lb., depending upon the seller. The red variety is quiet, with sellers at 2¾@3c. per lb. Spot bichromate of soda is obtainable at 8c. per lb. and some sales have been recorded on this basis. Odd lots might be purchased at 7½c. per lb. on a firm bid, but dealers were not inclined to name this price in the open market. Offerings were not heavy, but appeared to be sufficient to meet the current extent of the consuming demand. Prices on spot caustic soda have drifted to a lower level on resale stock. Prominent dealers quoted the market for standard brands at \$3.65@\$3.70 per 100 lb., but in some directions it was stated that \$3.60 could be done ex-dock New York. The general demand has not shown much activity during the past week and while it is not believed that resale supplies are heavy, there is a keener state of competition among the holders. Contract prices remain unchanged at 3½c. per lb., basis 60 per cent, f.o.b. works.

Scattered trading in nitrite of soda was reported at 7c. per lb., with sellers generally quoting 7@7½c. in the open market. Rumors were current that round lots might be purchased at slight concessions, but buyers are showing very little interest beyond the limit of actual requirements. Imported prussiate of soda showed somewhat of a decline during the beginning of the week, but strengthened considerably at the close. Sales have been reported at 11½@12c. per lb., with most sellers asking the outside figure. Foreign shipments are offered on the basis of 11c. per lb. c.i.f. New York. Imported sulphide of soda is being offered by dealers at 4½c. per lb. for the fused and 5½c. for the broken. Odd lots of the latter material could probably be purchased at 5@5½c. on a firm offer. Resale lots of light soda ash in single bags were a shade easier on spot, with sellers quoting \$1.90 per 100 lb., although 2c. per lb. was the prevailing asking price in most directions. Foreign shipments were offered at 1½c. per lb. c.i.f. and in one quarter 1½c. was named for prompt shipment from England.

Leading factors in cobalt oxide report sales at \$2.35@\$2.45 per lb., depending on the quantity. Prevailing quotations are the lowest named so far this year. Dealers of cream of tartar quote 28½c. per lb. and might do a little better on a firm offer. Producers continue to ask 33c. per lb., but are not getting much business at this price. Odd lots of oxalic acid of foreign and domestic manufacture are quoted by second hands at 17@17½c. per lb. Some producers are accepting business at the outside figure at the works. The extreme range of prices is from 17@19c. per lb., depending entirely upon the quantity, brand and seller. Buyers of tin oxide are showing a little more interest at the late reduction named by producers. Small-lot sales were reported at 38c. per lb.

COAL-TAR PRODUCTS

The coal-tar products market during the past week presented an appearance of calmness on the surface, but the undertone was diversified, making the situation somewhat difficult to analyze. In some quarters business is fairly active. Some products seem to be in demand, and where the condition holds true, brisk selling is taking place. Other products are dull and cannot be moved even at price concessions. Inquiries, in general, are more numerous, with the foreign element showing greater interest. Small-lot orders still form the bulk of sales, but discriminating consumers are showing an inclination to buy ahead when they are convinced that the product is selling at the rock-bottom figure. The low-priced resale material is being cleaned out of the market, but on some products manufacturers are feeling the competition quite keenly. The full importance of the action of the House on the dyestuff measure is now being realized both by manufacturers and consumers, with the result that the mental attitude of the trade is most unsettled. The majority of makers feel that full protection will be accorded them, but some consumers are reserving purchases until legislative action of a more definite nature is taken.

Sales of fair-sized lots of aniline oil were made at 18c. per lb. Smaller quantities are moving at higher prices. In some quarters 24c. per lb. is asked, but little buying is

being done at this level. The resale market seems well supplied, and with the present weak condition, a slight reduction is very probable. Producers of *benzene* are firm at 27@33c. per gal. for prime goods and 25@30c. for the 90 per cent. The present demand is exceeding the supply. Many coke ovens are still shut down with a consequent curtailment of supplies. Sales of fair-sized lots of *beta naphthol* were made at 34c. per lb. Odd lots of resale goods can be picked up as low as 32½c., but usually this material has been found to be old goods of inferior quality. The price range on *phenol* is varied at 9½@14c. per lb., depending upon seller, with resale lots at the lower level. Official Government resellers are quoting 12c. per lb. The demand is light and competition rather keen. Stocks of *dimethylaniline* are not as large as formerly, and offerings were heard at the close of the week at 42c. per lb., with many disposed to ask up to 44@45c. Producers of *diphenylamine* ask up to 67c. per lb. Some odd lots were known to have sold down to 56c. per lb. Resellers are stronger in their views and it is doubtful if the 60@61c. price could easily be done. Supplies of *cresylic acid* are plentiful, but the demand showed a spurt, with some contract business placed. Consumers have shown more inclination to buy ahead. The 97-99 per cent is quoted at 68@75c. per gal.

WAXES

Dullness continues to feature the market in *beeswax*. Prices, however, remain unchanged and nominal at former levels. Pure refined white wax is quoted at 40@45c. per lb. African crude ranges from 14@16c. per lb. South American brands are quoted on a basis of 21@25c. per lb. With trading practically at a standstill, the market on *carnauba wax* presents a weak tone and prices are purely nominal. No. 1 is available at 40@42c. per lb. and the No. 2 at 38@40c. No. 2 North Country was nominal at 25c. per lb. No. 3 North Country closed at 13½c. per lb. Firmer cables on *Japan wax* were received from the Orient, which resulted in the withdrawal of some offerings from the market. Spot stocks, however, were quoted unchanged at 16½@17c. per lb. The demand was of a hand-to-mouth character. Weakness in *paraffine wax* was the ruling feature of the market. Trading continues limited to small lots and quotations are unsteady. While scale wax was quoted at 2c. per lb., carlots, f.a.s. N. Y., it was stated that this price could be shaded on a firm bid for a round lot. Match wax closed unchanged at 3½c. per lb. The other grades of wax were also wholly nominal.

VEGETABLE OILS

While crushers of *castor oil* maintained prices on the basis of 9½c. per lb. for the No. 3 quality in barrels, outside lots were available at concessions. The recent advance in castor seed, however, has brought about a firmer undertone. There were offerings of *chinawood oil* for August arrival at New York at 11½c. per lb., in barrels, with the market barely steady as a result of the prevailing quiet conditions. In some directions it was intimated that 11c. might be done for August oil. Spot material remained scarce and quotations of 13@14c. per lb. were merely nominal. August-September shipments from the Orient closed at 10@10½c. c.i.f. New York, barrels included. No important transactions in the market were reported for *coconut oil*. Prices named showed little change. Manila operators ask on a basis of 7½c. per lb., loose, August-September shipment, c.i.f. Pacific Coast, while 7½c. was asked c.i.f. N. Y. arrivals. Offerings of *crude corn oil* in the Middle West were scanty and prices were more or less nominal around 7@7½c. per lb., sellers' tanks, f.o.b. Chicago, September delivery. Edible *olive oil* on spot was unsettled at \$1.90@\$2.25 per gal., with offerings in some directions rather liberal. Denatured on spot closed at \$1.25 per gal. *Lagos palm oil* was advanced to 6½c. per lb. c.i.f. N. Y., the rise being in sympathy with higher prices in Liverpool. *Niger oil* was marked up to 5½c. per lb. c.i.f. N. Y., prompt shipment from abroad. Domestic crude *peanut oil* closed at 7½@7½c. per lb., prime basis, tank cars, f.o.b. mills, although recent business was placed at 7½c. Oriental oil for prompt shipment from the Coast was scarce and closing prices were advanced to 7½@7½c. per lb., sellers' tanks.

The St. Louis Market

ST. LOUIS, Mo., Aug. 5, 1921.

There has been a very pronounced improvement in the activity of the drug and fine chemical market and buying has measurably increased, indicating that the summer lull has been passed and that consumers' stocks are very low, and furthermore that the resale lots are diminishing. The market on heavy chemicals was quite active the past two weeks and with inquiries coming from many of the larger consumers for the first time in many months, the future on heavy chemicals is decidedly optimistic. An appreciable amount of business is originating from the dye and textile manufacturers, and as a whole the present condition gives a very promising appearance for the future.

Caustic soda demand has been very good. Several of the large contract buyers are beginning to take out their allotments. Carload prices range from \$3.75@\$4.50 per 100 lb., basis 73-75 per cent solid, f.o.b. point of production. *Soda ash* continues at the manufacturers' prevailing schedule. *Bicarbonate of soda* demand has been very dull with prices holding at \$2.75 per 100 lb.

The activity in *carbon bisulphide* still prevails and a very nice business is being transacted. *Hypo* continues in a routine way. *Sulphur* continues to hold firm at \$2 per 100 lb. for the commercial in bags, with routine demand.

DRUGS AND PHARMACEUTICALS

The demand for *bismuth salts* has tremendously increased and manufacturers are in good position to fill orders promptly. Some certain *citrate salts* continue to move freely. Producers have reduced their price on *cream of tartar*, in spite of which the demand has been very good. A very good demand for *ether* from the hospital trade is being enjoyed. *Glycerine* has again declined and now holds at 14c. per lb. for both spot and contract with a fair demand. *Hydrogen peroxide* continues to move steadily through routine channels. *Iodides* have shown a fair increase. *Salicylates* are holding their own. *Sodium benzoate* is not moving as manufacturers expected. However, there has been a slight improvement. Factors have reduced their price on *strychnine*, but little is expected to result from this reduction, for the use of this commodity is limited and buyers will take on supplies only in about the same volume. *Zinc oxide* prices have not changed since June 27, although the demand during July for both leaded and lead-free fell off considerably. The manufacturers predict a picking up in the lead-free in the next two weeks and base these predictions on the increased demand since Aug. 1. *Zinc stearate* demand continues to increase.

ACIDS

Producers of heavy acids report a decided increase and are very optimistic regarding the future. *Sulphuric acid* is moving in a large volume to the oil-refining trade. Apparently consumers of heavy acids are again in operation and their stocks on hand are exhausted. Many inquiries for *benzoic acid* are being received and in many instances resulting in business. The market for *carbolic acid* retains the same steady tone that has been noted for some time past, with a fair inquiry and demand. The extreme hot weather which has recently prevailed has caused some increase in the demand for small quantities of *citric acid*. However, the situation still lacks any appreciable change. The demand for *phosphoric acid* has improved. Apparently the soft-drink manufacturers are substituting *tartaric acid* for *citric acid* and lately the consumption has been heavy.

VEGETABLE OILS AND PAINT MATERIALS

Linseed oil, after a temporary rise to 8½c., has settled to 7½c., basis raw. The demand for spot oil is fair, with no contracting being done. *Castor oil* enjoys a routine demand, with an advance of price to 11½c., in returnable drums for No. 1 U.S.P. *Turpentine* demand continues very fair considering the dull period the paint trade is now experiencing. The price has stiffened continuously the past week and today is quoted at 61½c. per gal.

Lithopone continues in fair demand with price the same. *Red oxides* have been in fair movement the past two weeks for the first time this year.

The Iron and Steel Market

PITTSBURGH, Aug. 5, 1921.

Gradual improvement in the demand upon the steel mills can be seen, but the improvement is very slow, particularly in tonnage. It is in the lighter lines that the improvement is more noticeable, particularly in sheets and tubular goods. Wire products recently showed a decided gain in demand, but the demand has decreased somewhat in the past few days. In the heaviest lines, rails and shapes, there is practically no change, and thus tonnage does not show much gain. The best guess is that the production of steel ingots in July was just under 20 per cent of capacity, taking the month as a whole, but production at the middle of the month was somewhat under the average. The first half of August will probably show a rate measurably above 20 per cent.

The character of the demand upon the steel mills is still plainly marked as being for common everyday consumption, the increase in demand during the past three weeks being due to further depletion of stocks of steel in buyers' hands as well as distribution of stocks of various wares made of steel.

COMPETITION AND PRICES

There is not merely an "open market" in steel products, with each seller naming a particular price against each inquiry, but there is strenuous competition. The competition does not take the form of price slashing, the policy being rather reserved in that respect, and steel prices are now sagging rather than definitely declining. On the whole the steel market has really gone off rather gently. While there has been declines in some products that appeared rather spectacular, the fact in most cases was that what appeared like a straight reduction was really the open recognition of price-cutting that had been growing gradually. The general pace of decline is certainly much less rapid now and it is quite unlikely there will be any clear-cut breaks in future. The price on a 500-ton lot today may become the price on a 100-ton lot a fortnight hence and in a week or two the price on a single carload. Carload prices now may be quoted at 1.75c. for bars, 1.85c. for shapes and plates and 2.40c. for hoops or hot-rolled strips. In sheets the highest prices seriously asked are 2.40c. on blue annealed, 3.25c. on black and 4.25c. on galvanized. On some orders not particularly large as low as 3c. has been done on black and 4c. on galvanized, while it is rumored that in one or two special cases 3.75c. has been done on galvanized. An order of equal size in black would hardly bring out a price of 2.75c., the trend in close competition being to narrow the spread between black and galvanized to less than \$1 per 100 lb. The open quotation on plain wire is 2.50c., with \$2.75 regarded as the open market on rails.

Setting together the two facts that mills are rather reserved in cutting prices and altogether avoid any slashing, while it is generally claimed that to the average or typical mill present prices represent a loss, it may be surmised that mills are making quotations on a theoretical or prospective cost, based on what they expect to be able to do when they secure a fair rate of operation. With a mill operating at 15 or 20 or 30 per cent the actual computation of cost is not indicative of what could be done under reasonable conditions. The mills are in a condition never before experienced, for before the war it was a dictum that it was not feasible to operate a mill at less than about 50 per cent of capacity.

PIG IRON

A sale of 2,000 tons of basic iron made by a valley producer at \$18 furnace took \$1 off the quotable market. Bessemer is offered at \$20 valley, against \$20.50 a week ago. Foundry remains nominally quotable at \$19.50, though a firm offer for a round tonnage at a considerably lower price would probably bring results. The \$18 basic price is a phenomenon, since the transportation cost of assembling the coke, ore and limestone at a valley furnace is more than \$10. Sales at so much under present cost represent a desire to liquidate and an expectation that costs will be lower when it becomes necessary to make more iron. All the merchant furnaces in the valleys are idle.

General Chemicals

CURRENT WHOLESALE PRICES IN NEW YORK MARKET

	Carlots	Less Carlots
Acetic anhydride.....	lb. \$0.12 - .12	\$0.40 - \$0.45
Acetone.....	lb. 2.75 - 3.00	3.25 - 3.50
Acid, acetic, 28 per cent.....	100 lbs. 5.00 - 5.25	5.50 - 6.00
Acetic, 50 per cent.....	100 lbs. 10.00 - 10.25	10.50 - 10.75
Acetic, glacial, 99 per cent, carboys, 100 lbs.	10.00 - 10.25	10.50 - 10.75
Boric, crystals.....	lb. .13 - .14	.14 - .15
Boric, powder.....	lb. .15 - .15	.16 - .16
Citric.....	lb. .11 - .11	.14 - .15
Hydrochloric, 32 per cent.....	100 lb. 1.25 - 1.50	1.60 - 1.75
Hydrofluoric, 52 per cent.....	lb. .11 - .11	.12 - .12
Lactic, 44 per cent tech.....	lb. .10 - .11	.11 - .12
Lactic, 22 per cent tech.....	lb. .041 - .051	.06 - .07
Molyblic, C. P.....	lb. 4.00 - 4.50	4.50 - 5.00
Muriatic, 20 deg. (see hydrochloric).....	lb. .06 - .06	.07 - .07
Nitric, 40 deg.....	lb. .07 - .07	.07 - .07
Nitric, 42 deg.....	lb. .17 - .17	.17 - .19
Oxalic, crystals.....	lb. .13 - .14	.14 - .18
Phosphoric, 50 per cent solution.....	lb. .20 - .25	.27 - .35
Pieric.....	lb. .19 - .20	.19 - .21
Pyrogallol, resublimed.....	lb. .11 - .11	.11 - .14
Sulphuric, 60 deg., tank cars.....	ton 18.00 - 20.00	11.25 - 14.00
Sulphuric, 60 deg., drums.....	ton 21.00 - 22.00	13.00 - 15.00
Sulphuric, 66 deg., tank cars.....	ton 22.50 - 23.00	.....
Sulphuric, 66 deg., carboys, tank cars.....	ton 21.00 - 22.00	.....
Sulphuric, fuming, 20 per cent (oleum).....	ton 21.00 - 22.00	.....
Sulphuric, fuming, 20 per cent (oleum) drums.....	ton 23.00 - 23.50	24.00 - 24.50
Sulphuric, fuming, 20 per cent (oleum) carboys.....	ton 31.00 - 32.00	33.00 - 34.00
Tannic, U. S. P.....	lb. .45 - .48	.50 - .55
Tartaric, crystall.....	lb. .27 - .28	.....
Tungstic, per lb. of WO.....	lb. 1.30 - 1.40	4.65 - 4.85
Alcohol, Ethyl.....	gal. .11 - .11	.....
Alcohol, Methyl (see methanol).....	gal. .11 - .11	.....
Alcohol, denatured, 188 proof.....	gal. .31 - .36	.....
Alcohol, denatured, 190 proof.....	gal. .38 - .42	.....
Alum, ammonium, lump.....	lb. .031 - .031	.04 - .04
Alum, potassium, lump.....	lb. .031 - .04	.04 - .04
Alum, chrome, lump.....	lb. .10 - .11	.11 - .12
Aluminum sulphate, commercial.....	lb. .011 - .02	.02 - .02
Aluminum sulphate, iron free.....	lb. .03 - .03	.03 - .04
Aquamin, anhydrous, 26 deg., drums (750 lb.).....	lb. .07 - .07	.07 - .08
Ammonia, anhydrous, cyl. (100-150 lb.).....	lb. .30 - .32	.33 - .35
Ammonium carbonate, powder.....	lb. .08 - .08	.09 - .10
Ammonium chloride, granular (white salamone).....	lb. .061 - .061	.07 - .08
Ammonium chloride, granular (gray salamone).....	lb. .061 - .061	.07 - .07
Ammonium nitrate.....	lb. .07 - .07	.07 - .08
Ammonium sulphate.....	100 lb. 2.20 - 2.25	2.30 - 2.40
Amylacetate.....	gal. .11 - .11	.....
Amylacetate, tech.....	gal. .061 - .07	.07 - .08
Arsenic oxide, (white arsenic) powdered.....	lb. .11 - .11	.12 - .13
Arsenic, sulphide, powdered (red arsenic).....	ton 55.00 - 56.00	56.50 - 58.00
Barium chloride.....	lb. .20 - .21	.22 - .23
Barium dioxide (peroxide).....	lb. .071 - .071	.08 - .08
Barium nitrate.....	lb. .041 - .041	.041 - .051
Barium sulphate (precip.) (blue fixe).....	lb. .04 - .04	.04 - .05
Bleaching powder (see calx, hypochlorite).....	.....	.....
Blue vitriol (see copper sulphate).....	.....	.....
Borax (see sodium borate).....	.....	.....
Bromstone (see sulphur, roll).....	.....	.....
Bromine.....	lb. .41 - .42	.43 - .45
Calcium acetate.....	100 lbs. 2.00 - 2.05	.....
Calcium carbide.....	lb. .041 - .041	.05 - .05
Calcium chloride, fused, lump.....	ton 23.50 - 24.00	24.50 - 25.50
Calcium chloride, granulated.....	lb. .011 - .02	.021 - .021
Calcium hypochlorite (bleach'g powder) 100 lb.	2.15 - 2.25	2.35 - 2.50
Calcium peroxide.....	lb. .11 - .11	.14 - .15
Calcium phosphate, tribasic.....	lb. .11 - .11	.15 - .16
Camphor.....	lb. .061 - .061	.07 - .08
Carbon bisulphide.....	lb. .101 - .101	.11 - .12
Carbon tetrachloride, drums.....	lb. .101 - .101	.60 - .75
Carbonyl chloride (phosgene).....	.....	.....
Caustic potash (see potassium hydroxide).....	.....	.....
Caustic soda (see sodium hydroxide).....	.....	.....
Chlorine, gas, liquid-cylinders (100 lb.).....	lb. .08 - .09	.09 - .10
Chloroform.....	lb. .11 - .11	.38 - .43
Cobalt oxide.....	lb. .11 - .11	2.35 - 2.40
Copperas (see iron sulphate).....	.....	.....
Copper carbonate, green precipitate.....	lb. .19 - .19	.20 - .21
Copper cyanide.....	lb. .05 - .05	.50 - .62
Copper sulphate, crystals.....	lb. .051 - .06	.061 - .061
Cream of tartar (see potassium bitartrate).....	.....	.....
Epsom salt (see magnesium sulphate).....	.....	.....
Ethyl Acetate Com. 85%.....	gal. .100 - 1.10	.....
Ethyl Acetate pure (acetic ether 98% to 100%).....	lb. .50 - .52	.....
Formaldehyde, 40 per cent.....	lb. .12 - .13	.13 - .13
Fusel oil, ref.	gal. 3.25 - 3.75	.....
Fusel oil, crude.....	gal. 1.75 - 2.00	.....
Glauber's salt (see sodium sulphate).....	.....	.....
Glycerine, C. P. drums extra.....	lb. .11 - .11	.....
Iodine, resublimed.....	lb. .05 - .05	.05 - .05
Iron oxide, red.....	lb. .10 - .10	.20 - .20
Iron sulphate (coppers).....	ton 19.00 - 20.00	21.00 - 22.00
Lead acetate.....	lb. .09 - .09	.11 - .11
Lead arsenite, paste.....	lb. .09 - .09	.10 - .11
Lead nitrate.....	lb. .071 - .071	.15 - .20
Litharge.....	lb. .071 - .071	.08 - .08
Lithium car bonate.....	lb. .13 - .13	1.30 - 1.40
Magnesium carbonate, technical.....	lb. .09 - .09	.10 - .11
Magnesium sulphate, U. S. P.	100 lb. 2.40 - 2.75	1.20 - 1.60
Magnesium sulphate, technical.....	100 lb. .77 - .77	.79 - .88
Methanol, 95%.....	gal. .80 - .80	.88 - .88
Methanol, 97%.....	gal. .12 - .12	.12 - .12
Nickel salt, double.....	lb. .14 - .14	1.41 - 1.41
Nickel salt, single.....	lb. .11 - .11	1.12 - 1.12
Phosgene (see carbonyl chloride).....	.....	.....
Phosphorus, red.....	lb. .45 - .46	.47 - .50
Phosphorus, yellow.....	lb. .35 - .35	.37 - .37
Potassium bichromate.....	lb. .111 - .111	.12 - .12

	Carlots	Less Carlots
Potassium bitartrate (cream of tartar)	lb. \$	\$0.281-\$0.291
Potassium bromide, granular	lb.	16
Potassium carbonate, U. S. P.	lb. .35	45
Potassium carbonate, 80-85%	lb. .05 . . . .	.06
Potassium chloride, crystals	lb. .08 . . . .	.09
Potassium cyanide	lb. . . . .	.26
Potassium hydroxide (caustic potash)	lb. .04 . . . .	.05
Potassium muriate, 80% K.C.I.	ton 45.00	50.00
Potassium iodide	lb.	2.75
Potassium nitrate	lb. .09	10
Potassium permanganate	lb. .26 . . . .	.27
Potassium prussiate, red	lb. .28 . . . .	.29
Potassium prussiate, yellow	lb. .21 . . . .	.22
Potassium sulphate (powdered)	per unit	1.35
Rochelle salts (see sodium potas tartrate)	ton	—
Sal ammoniac (see ammonium chloride)	ton	—
Salt soda (see sodium carbonate)	ton	—
Salt cake	ton	22.00
Silver cyanide	oz.	1.35
Silver nitrate	oz. . . . .	.40
Soda ash, light	100 lb. 1.95	2.00
Soda ash, tense	100 lb. 2.35	2.45
Sodium acetate	lb. .04 . . . .	.04
Sodium bicarbonate	100 lb. 2.25	2.50
Sodium bichromate	lb. .08 . . . .	.08
Sodium bisulphite (nitre cake)	ton 5.00	5.50
Sodium bisulphite powdered, U.S.P.	lb. .05 . . . .	.05
Sodium borate (borax)	lb. .05 . . . .	.06
Sodium carbonate (soda)	100 lb. 1.90	2.10
Sodium chl rate	lb. .07 . . . .	.07
Sodium cyanide	lb. .19 . . . .	.21
Sodium fluoride	lb. .11 . . . .	.12
Sodium hydroxide (caustic soda)	100 lb. 3.60	3.80
Sodium hyposulphite	ton	0.31
Sodium nitrate	100 lb. 2.10	2.30
Sodium nitrite	lb. .07 . . . .	.07
Sodium peroxide, powdered	lb. .25 . . . .	.27
Sodium phosphate, dibasic	lb. .04 . . . .	.05
Sodium potassium tartrate (Rochelle salts)	ton	26
Sodium prussiate, yellow	lb. .11 . . . .	.12
Sodium silicate, solution (40 deg.)	100 lb. 1.00	1.15
Sodium silicate, solution (60 deg.)	lb. .02 . . . .	.03
Sodium sulphate, crystals (Glauber's salt)	100 lb. 1.50	1.75
Sodium sulphide, f.s. sed. 60-62 per cent (cone)	lb. .04 . . . .	.05
Sodium sulphite, crystals	lb. .03 . . . .	.04
Strontium nitrate, powdered	lb. .15 . . . .	.16
Sulphur chl ride, red	lb. .07 . . . .	.07
Sulphur, crude	ton 20.00	22.00
Sulphur dioxide, liquid, cylinders extra	lb. .08 . . . .	.08
Sulphur (sublimed), flour	100 lb.	2.25
Sulphur, roll (brimstone)	100 lb.	2.00
Tin bichloride, 50 per cent	lb. .18 . . . .	.19
Tin oxide	lb. .15 . . . .	.16
Zinc carbonate, precipitate	lb. .11 . . . .	.11
Zinc chloride, gran.	lb. .45 . . . .	.49
Zinc cyanide	lb. .11 . . . .	.11
Zinc dust	lb. .07 . . . .	.07
Zinc oxide, XX	100 lb. 3.00	3.25
Zinc sulphate	100 lb.	3.30

Coal-Tar Products

NOTE—The following prices are for original packages in large quantities:

Alpha-naphthol, crude	lb. \$1.10	\$1.15
Alpha-naphthol, refined	lb. 1.25	1.30
Alpha-naphthylamine	lb. .35 . . . .	.40
Aniline oil, drums extra	lb. .18 . . . .	.21
Aniline salts	lb. .25 . . . .	.28
Anthracene, 80% in drums (100 lb.)	lb. .75	1.00
Benzaldehyde U.S.P.	lb. 1.00	1.25
Benzidine, base	lb. .85	1.00
Benzidine sulphate	lb. .75 . . . .	.85
Benzoic acid, U.S.P.	lb. .60 . . . .	.65
Benzolate of soda, U.S.P.	lb. .55 . . . .	.60
Benzene, pure, water-white, in drums (100 gal.)	gal. .27 . . . .	.32
Benzene, 90%, in drums (100 gal.)	gal. .25 . . . .	.28
Benzyl chloride, 95-97%, refined	lb. .25 . . . .	.27
Benzyl chloride, tech.	lb. .20 . . . .	.23
Beta-naphthol benzoate	lb. 3.50	4.00
Beta-naphthol, sublimed	lb. .70 . . . .	.75
Beta-naphthol, tech.	lb. .32 . . . .	.37
Beta-naphthylamine, sublimed	lb. 1.75	1.80
Cresol, U. S. P., in drums (100 lb.)	lb. .16 . . . .	.18
Ortho-cresol, in drums (100 lb.)	lb. .25 . . . .	.27
Cresylic acid, 97-99%, straw color, in drums	gal. .68 . . . .	.75
Cresylic acid, 75-97%, dark, in drums	gal. .65 . . . .	.70
Cresylic acid, 50%, first quality, drums	gal. .45 . . . .	.50
Dichlorbenzene	lb. .06 . . . .	.09
Diethylaniline	lb. 1.20	1.25
Dimethylaniline	lb. .42 . . . .	.50
Dinitrobenzene	lb. .26 . . . .	.28
Dinitrochlorbenzene	lb. .20 . . . .	.30
Dinitronaphthalene	lb. .30 . . . .	.40
Dinitrophenol	lb. .35 . . . .	.40
Dinitrotoluene	lb. .27 . . . .	.30
Dip oil, 25%, car lots, in drums	gal. .40 . . . .	.45
Diphenylamine	lb. .60 . . . .	.65
H-acid	lb. 1.15	1.25
Meta-phenylenediamine	lb. 1.15	1.20
Monochlorbenzene	lb. .12 . . . .	.14
Naphthylamine	lb. 1.75	1.85
Naphthalene crushed, in bbls.	lb. .06 . . . .	.08
Naphthalene, flake	lb. .06 . . . .	.08
Naphthalene, balls	lb. .08 . . . .	.09
Naphthionic acid, crude	lb. .70 . . . .	.75
Nitrobenzene	lb. .12 . . . .	.15
Nitro-naphthalene	lb. .30 . . . .	.35
Nitro-toluene	lb. .16 . . . .	.18
Ortho-aminophenol	lb. 3.10	3.20
Ortho-dichlor-benzene	lb. .15 . . . .	.20
Ortho-nitro-phenol	lb. .80 . . . .	.85
Ortho-nitro-toluene	lb. .15 . . . .	.20
Ortho-toluidine	lb. .20 . . . .	.25
Para-amidophenol, base	lb. 1.40	1.45
Para-amidophenol, HCl	lb. 1.60	1.75

Para-dichlorbenzene	lb. .15 . . . .	.20
Paranitroaniline	lb. .75 . . . .	.80
Para-nitrotoluene	lb. .85 . . . .	.95
Para-phenylenediamine	lb. 1.20	1.95
Para-toluidine	lb. 1.25	1.40
Phthalic anhydride	lb. .50 . . . .	.60
Phenol, U. S. P., drums	lb. .09 . . . .	.11
Pyridine	gal. 2.00	3.50
Resorcinol, technical	lb. 1.60	1.65
Resorcinol, pure	lb. 2.25	2.30
Salicylic acid, U. S. P.	lb. .75 . . . .	.80
Salol	lb. .19 . . . .	.22
Solvent naphtha, water-white, in drums, 100 gal.	gal. .25 . . . .	.28
Solvent naphtha, crude, heavy, in drums, 100 gal.	gal. .14 . . . .	.16
Sulphanilic acid, crude	lb. .30 . . . .	.35
Tolidine	lb. 1.25	1.35
Tolidine, mixed	lb. .40 . . . .	.45
Toluene, in tank cars	gal. .25 . . . .	.28
Toluene, in drums	gal. .40 . . . .	.45
Xyliodines, drums, 100 gal.	gal. .45 . . . .	.45
Xylene, pure, in drums	gal. .33 . . . .	.35
Xylene, pure, in tank cars	gal. .30 . . . .	.30
Xylene, commercial, in drums	gal. .03 . . . .	.03
Xylene, commercial, in tank cars	gal. .10 . . . .	.10

Waxes

Prices based on original packages in large quantities.	
Beeswax, refined, dark	lb. \$0.24
Beeswax, refined, light	lb. .27
Beeswax, white pure	lb. .40
Carnauba, Flora	lb. .58
Carnauba, No. 2, North Country	lb. .25
Carnauba, No. 3, North Country	lb. .13
Japan	lb. .16
Montan, crude	lb. .06
Paraffine waxes, crude match wax (white) 105-110 m.p.	lb. .03
Paraffine waxes, crude, scale 124-126 m.p.	lb. .02
Paraffine waxes, refined, 118-120 m.p.	lb. .03
Paraffine waxes, refined, 125 m.p.	lb. .03
Paraffine waxes, refined, 128-130 m.p.	lb. .04
Paraffine waxes, refined, 133-135 m.p.	lb. .04
Paraffine waxes, refined, 135-137 m.p.	lb. .05
Stearic acid, single pressed	lb. .09
Stearic acid, double pressed	lb. .09
Stearic acid, triple pressed	lb. .10

Naval Stores

All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.	
Rosin B-D, bbl.	280 lb. \$4.85
Rosin E-I	280 lb. 4.90
Rosin K-N	280 lb. 5.30
Rosin W. G.-W. W.	280 lb. 6.50
Wood rosin, bbl.	280 lb. 6.25
Spirits of turpentine	gal. .63
Wood turpentine, steam dist.	gal. .61
Wood turpentine, dest. dist.	gal. .59
Pine tar pitch, bbl.	200 lb. .70
Tar, kiln burned, bbl. (500 lb.)	500 lb. .11 .50
Retort tar, bbl.	500 lb. .11 .50
Rosin oil, first run	gal. .35
Rosin oil, second run	gal. .37
Rosin oil, third run	gal. .41
Pine oil, steam dist., sp.gr. 0.930-0.940	gal. \$1.80
Pine oil, pure, dest. dist.	gal. 1.50
Pine tar oil, ref., sp.gr. 1.025-1.035	gal. .46
Pine tar oil, crude, sp.gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal. .35
Pine tar oil, double ref., sp.gr. 0.965-0.990	gal. .75
Pine tar, ref., thin, sp.gr. 1.080-1.960	gal. .35
Turpentine, crude, sp.gr. 0.900-0.970	gal. 1.20
Hardwood oil, f.o.b. Mich., sp.gr. 0.960-0.990	gal. .35
Pinewood creosote, ref.	gal. .52

Solvents

73-76 deg., steel bbls. (85 lb.)	gal. \$0.41
70-72 deg., steel bbls. (85 lb.)	gal. .39
68-70 deg., steel bbls. (85 lb.)	gal. .38
V. M. and P. naphtha, steel bbls. (85 lb.)	gal. .30
Crude Rubber	
Para—Upriver fine	lb. \$0.16
Upriver coarse	lb. .09
Upriver caucho ball	lb. .11
Plantation—First latex crepe	lb. .14
Ribbed smoked sheets	lb. .12
Brown crepe, thin, clean	lb. .15
Amber crepe No. 1	lb. .17
Oils	
VEGETABLE	
The following prices are f.o.b. New York for carload lots.	
Castor oil, No. 3, in bbls.	lb. .10
Castor oil, AA, in bbls.	lb. .12
China wood oil, in bbls. (f.o.b. Pac. coast)	lb. .09
Cocoon oil, Ceylon grade, in bbls.	lb. .10
Cocoon oil, Cochin grade, in bbls.	lb. .10
Corn oil, crude, in bbls.	lb. .08
Cottonseed oil, crude (f. o. b. mill)	lb. .07
Cottonseed oil, summer yellow	lb. .09
Cottonseed oil, winter yellow	lb. .10
Linseed oil, raw, car lots (domestic)	gal. .75
Linseed oil, raw, tank cars (domestic)	gal. .69
Linseed oil, in 5-bbl lots (domestic)	gal. .77

Olive oil, Denatured.....	gal.	\$1.25	—	\$1.30
Palm, Lagos.....	lb.	.06	—	.07
Palm, Niger.....	lb.	.05	—	.05
Peanut oil, crude, tank cars (f.o.b. mill).....	lb.	.07	—	.07
Peanut oil, refined, in bbls.....	lb.	.10	—	.10
Rapeseed oil, refined in bbls.....	gal.	.90	—	.92
Rapeseed oil, blown, in bbls.....	gal.	.94	—	.95
Soya bean oil (Manchurian), in bbls, N. Y.	gal.	.08	—	—
Soya bean oil, tank cars, f.o.b., Pacific coast.....	lb.	.06	—	—

FISH

Light pressed menhaden.....	gal.	\$0.42	—	—
Yellow bleached menhaden.....	gal.	.44	—	—
White bleached menhaden.....	gal.	.46	—	—
Blown menhaden.....	gal.	.50	—	—

Miscellaneous Materials

All f.o.b. New York Unless Otherwise Stated

Barytes, ground, white, f.o.b. Kings Creek, S. C.	net ton	\$24.00	—	30.00
Barytes, ground, off color, f.o.b. Kings Creek.....	net ton	22.00	—	26.00
Barytes, crude, 88% to 94% ba., Kings Creek.....	net ton	10.00	—	12.00
Barytes, floated, f.o.b. St. Louis.....	net ton	26.50	—	28.00
Barytes, crude, first grade, Missouri.....	net ton	7.00	—	—
Blanc fixe, dry.....	lb.	.04	—	.04
Blanc fixe, pulp.....	net ton	45.00	—	55.00
Cavein.....	lb.	.01	—	.07
Chalk, domestic, extra light.....	lb.	.04	—	.05
Chalk, domestic, light.....	lb.	.04	—	.04
Chalk, domestic, heavy.....	lb.	.03	—	.04
Chalk, English, extra light.....	lb.	.04	—	.05
Chalk, English, light.....	lb.	.04	—	.05
Chalk, English, dense.....	lb.	.04	—	.04
China clay (kaolin) crude, f.o.b. mines, Georgia.....	net ton	8.00	—	10.00
China clay (kaolin) washed, f.o.b. Georgia.....	net ton	12.00	—	15.00
China clay (kaolin) powdered, f.o.b. Georgia.....	net ton	18.00	—	22.00
China clay (kaolin) crude f.o.b. Virginia points.....	net ton	8.00	—	12.00
China clay (kaolin) ground, f.o.b. Virginia points.....	net ton	15.00	—	25.00
China clay (kaolin), imported, lump.....	net ton	12.00	—	20.00
China clay (kaolin), imported, powdered.....	net ton	20.00	—	25.00
Feldspar, crude, f.o.b. Maryland and North Carolina points.....	et ton	5.00	—	7.50
Feldspar, crude, f.o.b. Maine.....	net ton	7.50	—	10.00
Feldspar, ground, f.o.b. Maine.....	net ton	21.00	—	23.00
Feldspar, ground, f.o.b. North Carolina.....	net ton	17.00	—	21.00
Feldspar, ground, f.o.b. N. Y. State.....	net ton	17.00	—	21.00
Feldspar, ground, f.o.b. Baltimore.....	net ton	27.00	—	30.00
Fuller's earth, f.o.b. Mine.....	net ton	16.00	—	17.00
Fuller's earth, granular, f.o.b. J. P.	net ton	15.00	—	18.00
Fuller's earth, powdered, f.o.b. Fla.	net ton	18.00	—	—
Fuller's earth, imported, powdered.....	net ton	24.00	—	27.00
Graphite, Ceylon, lump, first quality.....	lb.	.07	—	.07
Graphite, Ceylon, chip.....	lb.	.05	—	.05
Graphite, high grade amorphous crude.....	lb.	.02	—	.03
Magnesite, calcined.....	per ton	66.00	—	70.00
Pumice stone, imported, lump.....	lb.	.04	—	.50
Pumice stone, domestic lump.....	lb.	.05	—	.05
Pumice stone, ground.....	lb.	.06	—	.07
Quartz (acid tower) first to head, f.o.b. Baltimore.....	net ton	—	—	10.00
Quartz (acid tower) 1 1/2@2 in., f.o.b. Baltimore.....	net ton	—	—	14.00
Quartz (acid tower) rice, f.o.b. Baltimore.....	net ton	—	—	17.00
Quartz, lump, f.o.b. North Carolina.....	net ton	5.00	—	7.50
Shellac, orange fine.....	lb.	.52	—	.53
Shellac, orange superfine.....	lb.	.55	—	.56
Shellac, A. C. garnet.....	lb.	.44	—	.45
Shellac, T. N.	lb.	.45	—	.45
Soapstone.....	ton	12.00	—	15.00
Sodium chloride.....	long ton	12.50	—	13.00
Talc, paper-making grades, f.o.b. Vermont.....	ton	11.00	—	20.00
Talc, roofing grades, f.o.b. Vermont.....	ton	8.50	—	13.00
Talc, rubber grades, f.o.b. Vermont.....	ton	11.00	—	18.00
Talc, powdered, Southern, f.o.b. car.....	ton	10.00	—	14.00
Talc, imported.....	ton	33.00	—	40.00
Talc, California talcum powder grade.....	ton	18.00	—	40.00

Refractories

Bauxite brick, 56% Al, f.o.b. Pittsburgh.....	per 'on \$37.50-40.00	—	—	—
Carborundum refactory brick, 9-1/2 in.	{ less than 1 ft.	1,000	1250.00	—
Chrome brick, f.o.b. Eastern shipping points.....	1,000	1100.00	—	—
Chrome cement, 40-45% Cr ₂ O ₃	net ton	60	—	—
Chrome cement, 40-45% Cr ₂ O ₃ , sacks, in car lots, f.o.b. Eastern shipping points.....	net ton	30-35	—	—
Fireclay brick, 1st quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works.....	1,000	36-40	—	—
Fireclay brick, 2nd quality, 9-in. shapes, f.o.b. Pennsylvania, Ohio and Kentucky works.....	1,000	30-35	—	—
Magnesite brick, 9-in. straight.....	net ton	70	—	—
Magnesite brick, 9-in. arches, wedges and keys.....	net ton	77	—	—
Magnesite brick, soaps and splits.....	net ton	98	—	—
Silica brick, 9-in. sizes, f.o.b. Chicago district.....	1,000	42-45	—	—
Silica brick, 9-in. sizes, f.o.b. Birmingham district.....	1,000	45-50	—	—
Silica brick, 9-in. sizes, f.o.b. Mt. Union, Pa.	1,000	35-38	—	—

Ferro-Alloys

All f.o.b. Works

Ferro-titanium, 15-18%, f.o.b. Niagara Falls, N. Y.	net ton	\$200.00	—	\$225.00
Ferrochrome per lb. of Cr. contained, 6-8% carbon, carlots.....	lb.	.14	—	—
Ferrochrome, per lb. of Cr. contained, 4-6% carbon, carlots.....	lb.	.15	—	—
Ferromanganese, 76-80% Mn, domestic.....	net ton	65.00	—	70.00
Ferromanganese, 76-80% Mn, English.....	net ton	65.00	—	70.00
Spiegeleisen, 18-22% Mn.....	net ton	26.00	—	27.00
Ferro-silicon, 10-15%.....	net ton	40.00	—	42.00
Ferro-silicon, 50%.....	net ton	65.00	—	68.00
Ferro-silicon, 75%.....	re. ton	135.00	—	138.00
Jerrotung-tin, 70-80% per lb. of contained W.....	lb.	.45	—	.50
Ferrouranium, 35-50% of U, per lb. of U content.....	lb.	.60	—	—
Ferrovaniadium, 30-40% per lb. of contained V.	lb.	4.25	—	4.50

CHEMICAL AND METALLURGICAL ENGINEERING

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Ores and Semi-finished Products

All f.o.b. New York, Unless Otherwise Stated

Bauxite, 52% Al content.....	net ton	\$8.00	—	\$10.00
Chrome ore, Calif. concentrates, 50% min. Cr ₂ O ₃	unit	.30	—	.33
Chrome ore, 50% Cr ₂ O ₃ , f.o.b. Atlantic seaboard.....	unit	.30	—	.33
Coke, foundry, f.o.b. ovens.....	net ton	4.00	—	4.50
Coke, furnace, f.o.b. ovens.....	net ton	2.75	—	3.00
Coke, petroleum, refinery, Atlantic seaboard.....	net ton	14.00	—	15.00
Fluorspar, lump, f.o.b. mines, New Mexico.....	net ton	12.50	—	—
Fluorspar, standard, domestic washed gravel Kentucky and Illinois mine.....	net ton	20.00	—	—
Ilmenite, 52% TiO ₂ , per lb. ore.....	lb.	.01	—	.01
Manganese ore, 50% Mn, c.i.f. Atlantic seaport.....	unit	.22	—	—
Manganese ore, chemical (MnO ₂).....	ne. ton	50.00	—	\$5.00
Molybdenite, 85% MoS ₂ , per lb. of MoS ₂ , N. Y.	lb.	.55	—	.60
Monazite, per unit of ThO ₂ , c.i.f. Atlantic seaport.....	unit	30.00	—	—
Pyrites, Spanish, fine, c.i.f. Atlantic seaport.....	unit	.12	—	.12
Pyrites, domestic, fines, f.o.b. mines, Ga.	unit	.11	—	.12
Kutile, 95% TiO ₂ , per lb. ore.....	lb.	.15	—	—
Tungsten, scheelite, 60% WO ₃ and over, per unit of WO ₃ (nominal) unit of WO ₃ , N. Y. C.	unit	2.75	—	3.00
Uranium ore (carnotite) per lb. of U ₃ O ₈	lb.	1.50	—	2.50
Uranium oxide, 96% per lb. contained U ₃ O ₈	lb.	2.25	—	2.50
Vanadium pentoxide, 99%.....	lb.	12.00	—	14.00
Vanadium ore, per lb. of V ₂ O ₅ contained.....	lb.	1.00	—	—
Zircon, washed, iron free.....	lb.	.03	—	—

Non-Ferrous Metals

New York Markets

Cents per Lb.	12.00
24.5@25	—
Antimony, wholesale lots, Chinese and Japanese.....	4
Nickel, ordinary (ingot).....	41.00
Nickel, electrolytic.....	44.00
Monel metal, spot and blocks.....	35.00
Monel metal, spot and blocks.....	38.00
Monel metal, sheet bars.....	40.00
Tin, 5-ton lots, S. rats.....	25.75
Lead, New York, spot.....	4.35
Lead, E. St. Louis, spot.....	4.15-4.20
Zinc, spot, New York.....	4.55
Zinc, spot, E. St. Louis.....	4.20

OTHER METALS

Silver (commercial).....	oz.	\$0.61
Cadmium.....	lb.	1.00-1.25
Bismuth (500 lb. lots).....	lb.	1.50@1.55
Cobalt.....	3.00@3.25	—
Magnesium (f.o.b. Philadelphia).....	lb.	1.25
Platinum.....	oz.	65.00
Iridium.....	oz.	160.00@180.00
Palladium.....	oz.	48.00-52.00
Mercury.....	75 lb.	43.50-45.00

FINISHED METAL PRODUCTS

Warehouse Prices

Cents per Lb.

Copper sheets, hot rolled.....	20.25
Copper bottoms.....	27.75
Copper rods.....	19.25
High brass wire.....	16.75
High brass rods.....	13.75
Low brass wire.....	18.25
Low brass rods.....	18.25
Brazed brass tubing.....	27.00
Brazed bronze tubing.....	31.75
Seamless copper tubing.....	21.00
Seamless high brass tubing.....	18.50

OLD METALS—The following are the dealers' purchasing prices in cents per pound:

New York Current Cleveland Chicago

Copper, heavy and crucible.....	9.00@2.25	9.25	9.50
Copper, heavy and wire.....	8.25@8.50	8.50	8.50
Copper, light and bottoms.....	7.00@7.25	7.50	7.25
Lead, heavy.....	3.00@3.25	3.25	3.25
Lead, tea.....	2.25@2.35	2.25	2.25
Brass, heavy.....	4.00@4.25	4.50	5.00
Brass, light.....	3.00@3.25	3.25	3.50
No. 1 yellow brass turnings.....	3.75@4.00	4.25	4.50
Zinc.....	2.00@2.25	2.00	2.25

Structural Material

Industrial

Financial, Construction and Manufacturers' News

Construction and Operation

California

BURBANK—The Western Glass Products Co., Hibernian Bldg., has awarded a contract to the Frank Meline Co., 6777 Hollywood Blvd., for the erection of a new 1- and 2-story, brick and steel plant, 100 x 500 ft., at Burbank, comprising an initial plant unit of a proposed large group of buildings.

BURBANK—The American Aluminum Metal Products Co., Los Angeles, is having plans prepared by Richard D. King, 519 Van Nuys Bldg., Los Angeles, for the erection of its proposed new plant at Burbank, the initial work to consist of a series of 7 buildings. The company has a 5-acre tract, and additional structures will be erected at a later date.

Delaware

WILMINGTON—The Atlas Powder Co., du Pont Bldg., has acquired a substantial interest in the United States Flashless Powder Co., with plant at Carrcroft, near Wilmington, and in the future the companies will work in close co-operation. Operations at the plant will be continued as heretofore.

Florida

TAMPA—The Southern Bottle Mfg. Co., recently organized with a capital of \$150,000, has awarded a contract to Oatley & Jones, Tampa, for the erection of its proposed new plant at Gary, near Tampa, 1-story, 60x150 ft., with wing extension, 36x52 ft. I. F. Jones is president.

TAMPA—The Grass Fiber Pulp Co. is perfecting plans for the erection of a new plant at Leesburg, Fla., for the manufacture of paper pulp from saw grass. W. F. Stovall is president.

TAMPA—The Nu-Tex Brick Co. has commenced the construction of a local plant to be equipped for an initial daily capacity of about 30,000 bricks per day. It is proposed to place the plant in service at the earliest possible date.

CHIPLEY—The Chipley Leather Mfg. Co., recently incorporated, has awarded a contract for the erection of its proposed new local plant on property lately acquired, with initial structure to be 75x125 ft. The factory will be equipped as a tannery and leather finishing plant for the production of leather specialties from fish skins. C. B. Dunn is president, and Frank Tuttle, general manager.

Illinois

CHICAGO—The American Tar Products Co., 208 South La Salle St., is completing plans for the erection of a new 1- and 2-story tar-refining plant at Thirty-ninth St. and Fifty-second Ave., estimated to cost about \$1,000,000, with machinery. The Koppers Co., Union Arcade Bldg., Pittsburgh, Pa., is engineer for the project.

Louisiana

LEESVILLE—The Louisiana Oil Refining Co. and the Caddo Central Oil & Refining Co. are planning for the rebuilding of the portions of their local distributing plants, destroyed by fire, July 23, with loss estimated at about \$25,000.

Maryland

BALTIMORE—The Cooknut Corp., Lexington and Paca Sts., recently organized with a capital of \$500,000 to manufacture lard substitutes and kindred products, is completing plans for the first unit of its proposed new plant, to be located on Carlton St. The main works will be 4-story, 80x100 ft., and will be supplemented with two 1-story structures, 28x56 ft., estimated to cost about \$135,000. The plant will be equipped for an initial production of about 60,000 lb. of material per day. W. R. Spruill is president.

BALTIMORE—The Maryland Vegetable Oil Co., Seventh Ave. and Sixteenth St., recently organized with a capital of \$1,000,000, has acquired a property at the location noted for the erection of a new plant. Preliminary plans are under way. It is said that the works will cost in excess of \$200,000. The company is headed by Enos S. Stockbridge and Roland H. Brady.

BALTIMORE—The Greenmount Iron Mfg. Co., 833 Greenmount Ave., will soon call for new bids for the erection of the proposed addition to its iron foundry, estimated to cost about \$15,000. Former bids, recently received, have been rejected.

Massachusetts

SOUTHBRIDGE—The Optical Abrasive Co., recently organized, has acquired a 3-story building in the Phillipsdale section, heretofore used as grist mill by the Phillips Co., for the establishment of a plant for the manufacture of abrasive products for optical grinding and other precision service. The structure will be remodeled and equipment installed at an early date.

AUBURN—The Bay State Brick & Stone Co., Haverhill, Mass., recently organized, has acquired the plant of the Worcester Brick Co. at West Auburn, which has been idle for about a year past. The company will make a number of improvements and proposes to commence production at an early date. George L. Baldwin, formerly connected with the Worcester company, is an official of the new organization.

Missouri

JOPLIN—The Chanute Smelter Co., Frisco Bldg., has completed plans and will commence construction at once on a new 1-story concentrating plant, 36 x 45 ft., estimated to cost about \$50,000. The structure will be located on the company's property at Baxter Springs, Kan.

SPRINGFIELD—The Springfield Tablet Mfg. Co., 300 North Jefferson St., recently organized with a capital of \$60,000 to manufacture writing tablets and other paper specialties, will install machinery and equipment in a local building. It is proposed to commence production at an early date. H. S. Jewell is president and manager; H. F. Chalfont is secretary and treasurer.

New Jersey

FORDS—The Norvell Chemical Co. is planning for the rebuilding of its local plant, destroyed by fire, July 25, with loss estimated at about \$400,000, including building and machinery. The main works was 3-story, 100 x 200 ft., and the plant gave employment to about 100 persons. The plant was formerly operated by the National Synthetic Co. Donald McKesson is president.

NEWARK—The Tower Mfg. Co., Doremus Ave., manufacturer of chemicals, is planning for the erection of a 1-story addition to its plant, 40 x 143 ft., estimated to cost about \$20,000.

NEWARK—The E. Walsh Co., 127-29 Odgen St., operating a metal working plant, has filed plans for the erection of a 1-story addition, 25 x 60 ft., to be equipped as a japanning shop.

New York

COLLEGE POINT—The I. B. Kleinert Rubber Co., 725 Broadway, New York, has awarded a contract to the White Construction Co., 95 Madison Ave., for the erection of a new 4-story and basement plant at Fifth Ave. and Eighteenth St., College Point, estimated to cost about \$150,000.

NEW YORK—The Mexican Producing & Refining Co., 136 Liberty St., has acquired a building on Grand Blvd., Palisades Park, N. J., under lease, for the establishment of a new oil laboratory. The structure will be improved and equipment installed at an early date. Montford S. Orth is president.

Ohio

WOOSTER—The Stellar Refinery Co., 607 Newark Bldg., Wooster, is taking bids for the erection of a new oil refinery at Marne, near Newark, O., estimated to cost about \$300,000 with equipment. The works will consist of a number of buildings, including power house and pumping plant. J. M. Jaflick is secretary.

CLEVELAND—The Sterling Brass Co., 4610-12 St. Clair Ave., has taken new bids on revised plans for the erection of its proposed new 2-story brass foundry and machine shop, 145 x 200 ft., at St. Catherine and East Ninety-third Sts., estimated to cost about \$60,000. S. L. Weil is president.

Oklahoma

BRISTOW—The H. F. Wilcox Oil & Gas Co. is perfecting plans for the construction of a new local oil refinery, with initial daily capacity of about 500 bbl.

Oregon

PORTLAND—The Portland Vegetable Oil Mills Co. has construction well under way on its new local plant on site recently acquired, forming the previous works of the Foundation Co. The machinery and equipment is expected to be installed in September and October, having the plant ready for service during the latter month. It is estimated to cost close to \$500,000 with machinery. C. A. Edwards is one of the heads of the company.

Pennsylvania

ALLENTEWON—The plant of the Allen Chemical Co., Fourteenth and Fifteenth Sts., and the Little Lehigh River, has been sold to the Allen Typewriter Co. Chemical manufacture at the plant was discontinued some months ago. The new owner will equip the structure for the manufacture of typewriter parts. James K. Bowen is head.

PHILADELPHIA—E. F. Drew & Co., Inc., Swanson St., near McKean St., manufacturer of oil products, has filed plans for the erection of a 1-story extension at its works.

NEW CASTLE—F. A. Sieberling, formerly head of the Goodyear Tire & Rubber Co., Akron, O., and associates have taken over the local plant of the New Castle Rubber Co. The works will be improved and in the future will be operated under the name of the Lehigh Tire & Rubber Co.; it is proposed to commence production at an early date, providing equipment for an output of about 500 tires and a like number of tubes daily.

Tennessee

MEMPHIS—The Mexican Oil & Refining Co., 510 McCall Bldg., is planning for the purchase of new oil-refining equipment for installation at its pants. J. J. Mundy is engineer.

PARIS—W. G. Adams and associates are planning for the establishment of a new plant on local site for the manufacture of sassafras oil specialties. A company is being organized to carry out the project.

Texas

HOUSTON—W. J. Doyle, industrial land commissioner, Houston Belt & Terminal Co., is developing plans with local interests for the erection of a new sugar mill on a site near Houston, comprising about 60 acres of property. The new mill with machinery is estimated to cost about \$1,250,000. It will be equipped for an initial output of about 600,000 lb. of sugar daily. It is proposed to commence construction at an early date.

DALLAS—The Hercules Brick Co., recently organized, is perfecting plans for the construction of a new plant on a site totaling about 16 acres of land on the Trinity River. The works will be equipped for an output of about 150,000 bricks per day, and are estimated to cost about \$75,000 with machinery. A. B. Salin is manager.

DALLAS—The Trinity Paper Mills, 620 Dallas County State Bank Bldg., are perfecting plans for the construction of a new pulp and paper mill at McKinney, Tex. The company also proposes the erection of a similar mill in the vicinity of Fort Worth, Tex. George F. Lull is president.

Washington

SPOKANE—The Consolidated Diamond Oil & Refining Co., Hutton Bldg., is planning for the construction of a new oil refinery on a site near the city, with initial output of about 500 bbl. per day. The plant is estimated to cost about \$100,000.

West Virginia

STAR CITY—The Star City Glass Co. is planning for the rebuilding of the portion of its works recently destroyed by fire.

Wisconsin

WAUSAU—The Marathon Rubber Products Co. has awarded a contract to the Wisconsin Engineering & Construction Co., Wausau, for the erection of a new local plant to cost about \$15,000, exclusive of equipment.

New Companies

THE ROBERTSON CHEMICAL CO., Money Point, near Portsmouth, Va., has been incorporated with a capital of \$500,000 to manufacture chemicals and chemical byproducts. F. B. Stephenson is president, and C. W. Jones, secretary, both of Norfolk, Va.

THE PENETRO CHEMICAL CO., New York, N. Y., has been incorporated under Delaware laws with capital of \$500,000 to manufacture chemicals and chemical compounds. Arthur W. Britton, 65 Cedar St., represents the company.

THE POSO OIL CO., Los Angeles, Cal., has been incorporated with a capital of \$250,000 to manufacture petroleum products. The incorporators are J. C. Gillham, L. K. Adams, and C. B. Andrews, Merchants National Bank Bldg. The same incorporators have also organized the Poso Kern Oil, with capital of \$250,000 to manufacture petroleum specialties.

THE PABLO HUMUS CO., South Jacksonville, Fla., has been incorporated with a capital of \$10,000 to manufacture fertilizer products. Robert Ranson is president; and J. H. Hickman, vice-president and general manager, both of South Jacksonville.

THE OLYMPIA SPARK PLUG CO., 39 East Schiller St., Chicago, Ill., has been incorporated with a capital of \$5,000 to manufacture spark plugs and kindred specialties. The incorporators are Cornelius C. McMahon, Secor Cunningham, Jr., and Kenneth B. Hawkins.

THE PATUXENT GUANO CO., 407 Vickers Bldg., Baltimore, Md., has been incorporated with a capital of \$75,000 to manufacture fertilizer products. The incorporators are Harry T. Deford and Carroll W. Clark.

THE INSTANT PRODUCTS CORP., Boston, Mass., has been incorporated with a capital of \$100,000, to manufacture chemicals, paints and adhesive compounds, etc. Stanley Morin, 21 Cambridge St., is president and treasurer.

THE AMERICAN GASOLINE CORP., 29 South LaSalle St., Chicago, Ill., has been incorporated with a capital of \$250,000, to manufacture petroleum and petroleum products. The incorporators are Lewis H. Scurlock, W. C. and T. Shelby Black.

THE HAXAGON CHEMICAL CO., 67 Margarita St., Newark, N. J., has filed notice of organization to manufacture chemicals and chemical byproducts. Frank E. Fitch, 20 Whittlesey Ave., East Orange, N. J., heads the company.

THE WATERPROOF PAPER PRODUCTS CO., Herkimer, N. Y., has been incorporated with a capital of \$50,000, to manufacture paper goods of various kinds. The incorporators are J. R. Hyer, J. Thompson and C. L. Palmer. The company is represented by C. L. Earl, Herkimer.

CHARLES E. CAMPBELL, INC., Elmhurst, L. I., has been incorporated with a capital of \$50,000, to manufacture rubber products. The incorporators are Charles E. Campbell, K. K. Hillibrant and L. G. Wolf, Elmhurst. The company is represented by Baucher & Ganty, 51 Chambers St., New York.

THE HAGAMAN REFINING CORP., Ranger, Tex., has been incorporated with a capital of \$150,000, to manufacture refined petroleum products. The incorporators are M. H. Hagaman and G. A. Clements.

THE ENAMEL PRODUCTS CORP., East Stroudsburg, Pa., has been incorporated with a capital of \$50,000, to manufacture enamelware specialties. Louis Rupprecht, East Stroudsburg, is treasurer.

THE EAST HAMPTON CORE CO., New York, has been incorporated with a capital of \$50,000, to manufacture cork products. The incorporators are A. and R. L. Miller, and S. R. Kaufman. The company is represented by Zodikow & Wieder, 305 Broadway.

THE QUICK KLEAN KEMICAL CO., Worcester, Mass., has been incorporated with a capital of \$10,000, to manufacture chemicals

and chemical byproducts. William Blumenthal is president; Samuel N. Baron, vice-president, and Morris Goldsmith, 37 June St., treasurer.

THE NEVADA-VENTURA OIL SYNDICATE, 422 American Ave., Long Beach, Cal., has filed notice of organization to manufacture petroleum products. The company is headed by D. M. Allen, Charles H. Read and W. H. Young.

THE GRAND RAPIDS METAL PRODUCTS CO., Grand Rapids, Mich., has been incorporated with a capital of \$25,000, to manufacture metal goods. The incorporators are John C. Miller, and Edgar R. Freeman, Grand Rapids.

THE CLERGIAS CHEMICAL CORP., Rochester, N. Y., has been incorporated with a capital of \$50,000, to manufacture chemicals and chemical byproducts. The incorporators are R. J. Fisher, C. H. Gunn and J. E. Britton. The company is represented by Sutherland & Dwyer, Insurance Bldg., Rochester.

THE CO-SERVICE OIL CO., Newark, N. J., has been incorporated with a capital of 8,000 shares of stock, no par value, to manufacture oil products. The incorporators are M. E. Russell, E. B. Irons and M. B. Walls, Newark. The company is represented by Benjamin Natal, Court House Square Bldg., Camden, N. J.

THE GROVE CHEMICAL CO., 1200 South Grove St., Irvington, Newark, N. J., has filed notice of organization to manufacture chemicals, lacquers and kindred products. Carl P. Olson, 844 Lyons Ave., Irvington, heads the company.

THE TONKIN FLAKE GRAPHITE CO., New York, N. Y., has been incorporated with a capital of \$150,000, to manufacture refined graphite products. The incorporators are J. J. Tonkin, I. Loewenberg and I. Oliver. The company is represented by Price Brothers, 271 Broadway.

THE ATLANTIC COTTON OIL CO., New York, N. Y., has been incorporated with a capital of \$100,000, to manufacture refined oil products. The incorporators are S. L. Lemmon, J. B. Pruyne and G. H. Salmon. The company is represented by F. J. Knorr, attorney, Albany, N. Y.

THE WAMESIT CHEMICAL CO., Tewksbury, Mass., has been incorporated with a capital of \$100,000, to manufacture chemicals and chemical byproducts. George Stevens is president; and John H. Murphy, 8 Shattuck St., Lowell, Mass., treasurer.

THE MICHIGAN REFINING CORP., Detroit, Mich., has been incorporated with a capital of \$100,000, to manufacture petroleum specialties and coal-tar products. The incorporators are Elmer Burrel, Henry J. Jebb and Nevitt Sturgeon, 1533 Elmhurst Ave.

THE PENNSYLVANIA CHEMICAL & RESEARCH CO., Pittsburgh, Pa., has been incorporated with a nominal capital of \$5,000, to manufacture chemical specialties. R. T. Rosell, Pittsburgh, is treasurer.

THE PUENTE HILLS OIL CO., Los Angeles, Cal., has been incorporated with a capital of \$600,000, to manufacture petroleum products. The incorporators are F. B. Clark, R. L. Brown and R. L. Colby, Chamber of Commerce Bldg., Los Angeles.

THE DU-RITE PRODUCTS CO., New York, N. Y., has been incorporated with a capital of \$25,000, to manufacture varnishes, polishes and kindred products. The incorporators are F. J. McEvoy and J. D. Ohlsson. The company is represented by H. S. Cook, 38 Park Row, New York.

W. A. RARICK, INC., Nanticoke, Pa., has been incorporated under Delaware laws, with capital of \$1,000,000, to manufacture dynamite and other high explosives. The incorporators are Thomas J. Morgan and T. J. Jones, Nanticoke; and William J. Thomas, Mountain Top, Pa. The company is represented by Arley B. Magee, Dover, Del.

THE HARING PAPER CORP., New York, N. Y., has been incorporated under Delaware laws, with capital of \$100,000, to manufacture paper products. Samuel B. Howard, 65 Cedar St., represents the company.

THE ARTESIA OIL CO., Los Angeles, Cal., has been incorporated with a capital of \$500,000, to manufacture petroleum products. The incorporators are J. H. Savage, E. A. Reed and P. E. Keeler, Long Beach, Cal. The company is represented by P. E. Keeler, First National Bank Bldg., Long Beach.

THE PENINSULA TIRE & RUBBER CO., Tampa, Fla., has been incorporated with a capital of \$1,500,000, to manufacture tires and general rubber products. A. B. McMullan is president; S. H. Rogers, Jr., secretary; and H. A. Van Auken, general manager.

Capital Increases, etc.

THE FOLEY PAPER MILLS, Rochester, N. Y., have filed notice of increase in capital from \$25,000 to \$50,000.

THE CAMPBELL MFG. & FOUNDRY CO., Muskegon, Mich., has filed notice of change of name to the Muskegon Castings Co.

THE THOMPSON & NORRIS CO., 212 Concord St., Brooklyn, N. Y., manufacturer of paper products, a New Jersey corporation, has filed notice of increase in capital from \$500,000 to \$2,000,000.

THE RAVENSWOOD GLASS CO., 4247 Lincoln Ave., Chicago, Ill., manufacturer of glass specialties, has filed notice of increase in capital from \$25,000 to \$50,000.

THE DIAMOND COLOR CO., Bloomfield, N. J., has filed a petition in bankruptcy, with liabilities stated at \$30,000. The company operates a plant at 67 Willett St., for the manufacture of chemicals and dyes, etc.

THE ATLANTIC BOTTLE CO., 90 West Broadway, New York, N. Y., manufacturer of glass bottles, has filed notice of increase in capital from \$60,000 to \$300,000.

THE REEDY FOUNDRY CO., 4600 Iowa St., Chicago, Ill., has filed notice of increase in capital from \$75,000 to \$150,000.

THE FRANKLIN OIL & GAS CO., Houston, Tex., has filed notice of change of name to the Cold Test Lubricant Corp.

Coming Meetings and Events

AMERICAN CERAMIC SOCIETY will hold its twenty-first annual meeting at St. Louis, Feb. 27 to March 2, 1922.

AMERICAN CHEMICAL SOCIETY, THE SOCIETY OF CHEMICAL INDUSTRY and the American Section of the latter society will hold a joint meeting in New York, Sept. 6 to 10.

AMERICAN GAS ASSOCIATION will hold its third annual convention in the Congress and Auditorium Hotels, Chicago, the week of Nov. 7.

AMERICAN ELECTROCHEMICAL SOCIETY will hold its fall meeting in Lake Placid, N. Y., Sept. 29 and 30, and Oct. 1.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS will hold its annual winter meeting at Baltimore, Md., Dec. 6 to 9. Headquarters will be at the Southern Hotel and the sessions will be held in the Engineers' Club.

AMERICAN INSTITUTE OF MINING AND METALLURGICAL ENGINEERS will hold its fall meeting at Wilkes-Barre, Pa., Sept. 12 to 17.

AMERICAN MINING CONGRESS AND NATIONAL EXPOSITION OF MINES AND MINING EQUIPMENT will hold its twenty-fourth annual convention in the Coliseum, Chicago, Oct. 17 to 22.

AMERICAN PEAT SOCIETY will hold its fifteenth annual convention at the Hotel Commodore, New York City, Sept. 7, 8 and 9.

AMERICAN SOCIETY FOR STEEL TREATING will hold its third annual convention and exhibition Sept. 19 to 24 at Indianapolis.

THE NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES (SEVENTH) will be held during the week of Sept. 12 in the Eighth Coast Artillery Armory, New York City.

NEW JERSEY CHEMICAL SOCIETY has discontinued meetings for the summer and will resume them in October.

SOCIETY OF CHEMICAL INDUSTRY (BRITISH) at the invitation of the Montreal section will hold its annual meeting in Montreal and other Canadian cities during the week of Aug. 29, 1921. Details will be printed in this magazine from time to time.

SOCIETY OF INDUSTRIAL ENGINEERS will hold its fall meeting at Springfield, Mass., Oct. 5 to 7.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY will hold its fall convention with the American Pulp and Paper Mill Superintendents' Association, at Washington, Philadelphia, Spring Grove, York, York Haven, Pa., and Wilmington, Del., Oct. 18 to 20.

The following meetings are scheduled to be held in Rumford Hall, the Chemists' Club, New York: Oct. 7—American Chemical Society, regular meeting; Oct. 14—Société de Chimie Industrielle, regular meeting; Oct. 21—Society of Chemical Industry, Grasselli Medal; Nov. 11—American Chemical Society (in charge), Society of Chemical Industry, Société de Chimie Industrielle, joint meeting; Nov. 18—American Electrochemical Society, regular meeting; Dec. 2—Society of Chemical Industry, regular meeting; Dec. 9—American Chemical Society, regular meeting.